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Southeastern Illinois Region Solid Waste Management System Analysis

Roy F. Weston, Inc, West Chester, PA

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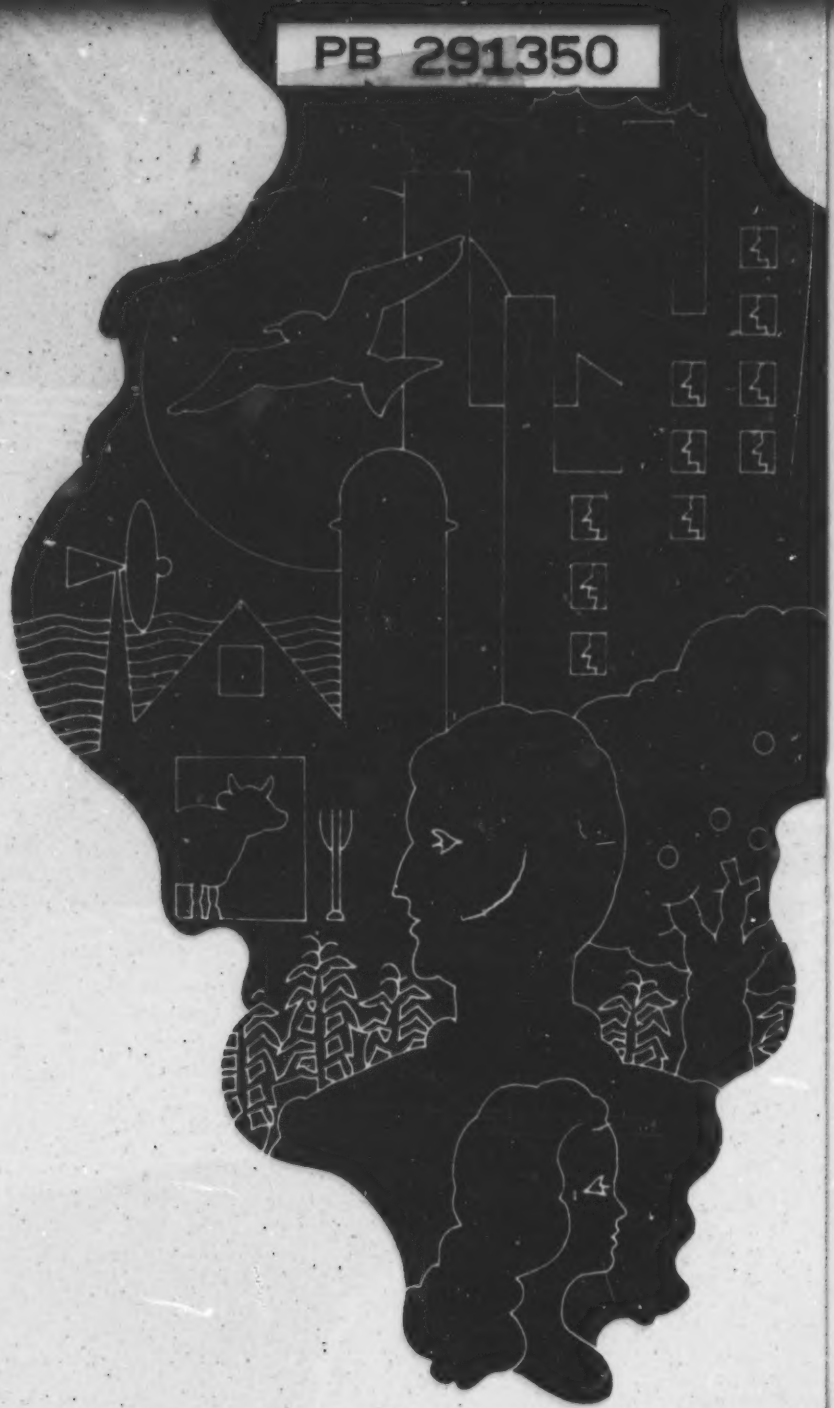

SOUTHEASTERN ILLINOIS REGION
SOLID WASTE MANAGEMENT SYSTEM ANALYSIS

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SOUTHEASTERN ILLINOIS REGION

SOLID WASTE MANAGEMENT

SYSTEM ANALYSIS

Roy F. Weston, Inc.

(IIEQ Document No. 74 - 36)

Project No. 40.001

State of Illinois

Illinois Institute for Environmental Quality

June, 1974

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The Need for Advance Planning in Illinois

In July, 1970, the Illinois General Assembly passed the Illinois Environmental Protection Act. This law expresses the determination of the people to improve the quality of the environment in Illinois. The Act addresses problems of air, water, land and noise pollution.

In 1973, the Illinois Pollution Control Board adopted new regulations for sanitary landfills. These regulations are enforced by the Illinois Environmental Protection Agency. The permit and inspection provisions established under these regulations are among the most comprehensive and vigorous in the United States. Each landfill operator is required to apply for a permit by April 27, 1974. The expense of meeting Illinois design and operating standards has and probably will cause some marginal landfill operations to close, thereby eliminating some environmentally unacceptable, but convenient, disposal sites.

The dwindling number of solid waste disposal sites has caused concern among municipal officials and private solid waste companies. Efforts to aquire new sites have often been thwarted by citizens who recognize the need for such facilities, but would rather see them located somewhere else.

The increased costs associated with everything these days have strained municipal budgets. Solid waste management is a large budget item. Elected officials are asking: Can this be reduced?

Over half of the solid waste in Illinois is managed by private companies. Their costs are increasing, and so are the rates charged to their clients. Public officials are asking: What is the cost of solid waste management? Should we go into business for ourselves?

In 1973, the energy crisis reinforced the long-standing argument by

environmentalists that something should be done to recover the resources going into solid waste. Solid waste managers now must cope with the added complexities of unproven recovery systems and an uncertain market for recovered commodities.

These and other pressing problems require planning. This study provides a basis for that planning by examining the economics of current solid waste management practices and proposed regional management strategies.

State Solid Waste Plan

The State Solid Waste Management Planning Project will examine the solid waste needs of Illinois and make recommendations as to actions that can be taken by the State to improve solid waste management generally. The Solid Waste Management Task Force of the Illinois Institute for Environmental Quality recognized from the start that solid waste management is a local responsibility and is subject to the specific desires of the people as to the services desired and the manner of satisfying these desires. Consequently, the task force suggested that the principal thrust of the State planning project should be to assist the work of local and regional planners who must prepare the specific recommendations for local officials.

This report is an analysis by the State and its consultants of several alternatives available to a specific region. Basic data used in the analysis was gathered by the regional planners, processed by the consultants, and rechecked by the regional planners. Elsewhere in the State plan, the planner will find reference data on the natural features of the State which will have an impact on solid waste management activities.

The Analytical Process

People and their activities produce solid waste. The first step in the planning procedure was to determine population and employment. Basic population projection data was generated by Argonne National Laboratory using historic census data and a predictive model. These projections were checked by the regional planner using local data and projections by the Illinois Office of Planning and Analysis (OPA). Tables 1 and 3 show examples of population and employment projections. Employment data was taken from the

Table 1

PROJECTED POPULATION EXAMPLE

LOCATION	1970	1975	1980	1985	1990	1995	2000
City A	305	305	350	360	390	400	410
City B	39,992	44,500	48,500	51,400	54,000	57,100	59,800
City C	2,435	2,780	3,010	3,230	3,440	3,690	3,910
City D	26,396	27,900	34,400	39,100	43,800	49,000	54,100
SUB TOTAL	69,128	75,385	86,260	94,090	101,630	110,190	118,220
UNINCORPORATED	21,754	23,400	24,200	24,800	25,300	25,900	26,400
COUNTY TOTAL	90,882	98,785	110,460	118,890	126,930	136,090	144,620

Table 2

AN ILLUSTRATION METHOD OF MUNICIPAL SOLID WASTE GENERATION

(1) Political Subdivision	(2) 1970 Population	(3) Area (mi.^{2})	(4) Population Density (2) ÷ (3)	(5) Log (4)	(6) 1.54 X (5)	(7) Generation Factor (6) - 0.68 #/cap./day	(8) Collection Rate (2) x (7) #/day	(9) Collection Rate (8) ÷ 285.7 ton/week
City A	305	0.17	1,794	3.25	5.01	4.33	1,320	4.6
City B	39,992	11.37	3,517	3.55	5.46	4.78	191,161	699.
City C	2,435	1.28	1,902	3.28	5.05	4.37	10,641	37.
City D	26,396	6.06	4,356	3.64	5.60	4.92	129,868	455.
Co. Remainder	21,358	1,157.	18.7	-	-	3.4	72,617	254.

Table 3

AN EXAMPLE OF THE EMPLOYMENT PROJECTIONS

SIC		1971	1975	1980	1985	1990	1995	2000
City B	207	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	2432	25	29	31	35	36	40	42
	3272	3	0	0	0	0	0	0
	358	1,500	2,470	2,750	3,020	3,220	3,630	4,010
City C	243	15	15	15	15	15	15	15
	271	4	1	0	0	0	0	0
City D	275	15	21	27	32	37	43	49
	278	60	79	100	140	170	210	240
	301	225	225	225	225	225	225	225
	327	32	32	35	35	35	35	35

Illinois Manufacturers' Association Directory as an historic data base. Employment projections are expressed in 3- and 4- digit Standard Industrial Classification (SIC) code (Table B-1, Appendix B).

Approved population projections are then multiplied by waste generation factors to give the municipal solid waste load (i.e. the residential and commercial wastes generated within a community).

Table 2 is an example of a tabular solution in which population is translated into a solid waste generation rate. (A more detailed explanation of the columns and the computational method is contained on Page B-1, Appendix B). Similarly, Table 4 gives a sample calculation in which employment is translated into tons of industrial wastes. The conversion factors (Table B-1, Appendix B) for converting employment data into tons of waste were derived by the consultant from data supplied by the USEPA. Table 5 shows, where there is no centrally located municipality, how the residential waste from unincorporated areas is allocated (on the basis of percentage of area) and combined with municipal and industrial wastes for the purpose of subsequent analyses. Wastes from unincorporated areas are considered to be located at the centroid of the township.

For long-term planning, consideration must be given to the annual change in generation rates. The computational methodology is shown on Table 6. A 2% and 3% per year increase in the generation factor was used for cities with more than 10,000 people and less than 10,000 people respectively.

Total waste quantities for the present (1973) and a future date (1990) are presented on Table 7. These waste quantities are, in turn, provided as input to a computerized model. The computer then determines the cost of hauling waste from the centroid of each source to each specified processing or disposal site. Transportation costs are added to site annual operating costs to determine a total annual system cost. It is within the capability of the computer model, if it is so instructed, to select the combinations of sources, processing facilities and ultimate sites which given the least (optimum) system cost.

Table 4

EXAMPLE OF INDUSTRIAL WASTE LOADING CALCULATION

(1) Location of Political Subdivision	(2) SIC Code	(3) Number of Employees in 1971	(4) Generation Factor (Ton/Empl/Yr)	(5) Production Rate (Ton/Yr) (3) x (4)	(6) Production Rate (Tons/Week) (5) ÷ 52	(7) Total Industrial Waste For Each Source (Ton/Week)
City A						0
City B	207	1,000	3.3	3,300.	63.4	
	2432	25	232.	5,800.	111.5	
	3272	9	154.	1,310	26.1	
	358	1,500	1.5	2,250	42.2	243.2
City C -	243	15	21.7	3 325.5	6.3	6.3
City D	275	15	1.1	16.5	-	
	278	60	2.6	156.	3	
	301	225	3.7	833.	16	
	327	32	15.	480.	9.2	28.2

Table 5

EXAMPLE OF COMPOSITE LOADING SHEET FOR BASE YEAR - 1973

Source Name	I.D#	SIC Load (Ton/Week)	Municipal Load (Ton/Week)	Area for Division of County Remainder $(Miles)^2$	Load due to County Remainder (Ton/Week)	Total Load (Ton/Week)
City A	101	-	4.6	9.7	54.6	59.2
City B	102	243.2	699.	10.	56.3	998.5
City C	103	6.3	37.	10.4	58.6	101.9
City D	104	28.2	455.	15.	84.5	567.7
				45.1	253.98	
County Remainder -		-	254			1727.3

Table 6

AN EXAMPLE OF THE COMPOSITE SHEET FOR WASTE LOADS (Ton/Week) FOR 1990

Source Name	I.D.#	1990 Industrial Load (Ton/Week)	1970 Generation Rate (#/cap./day)	% Increase Per Year	Total % Increase	1990 Generation Factor (#/cap./day)	1990 Municipal Waste Loads (Ton/Week)	County Area Factor	County Remainder Based on Area (Ton/Week)	1990 Total Waste Loads (Ton/Week)
City A	101	-	4.33	3	60	6.9	9.4	36	94.3	103.7
City B	102	360	4.78	2	40	6.35	1264.	48	125.7	1389.7
City C	103	6	4.37	3	60	6.99	84.3	64	167.7	252.
City D	104	36	4.92	2	40	7.87	1207.	36	94.3	1301.3
County Remainder			3.4	3	60	5.44	482	184		3046.7

Table 7

EXAMPLE OF THE STUDY PERIOD SOURCE INVENTORY

SOURCE NAME	SOURCE ID NO.	1973 VALUES QUANTITY (Tons/Week)	1990 VALUE QUANTITY (Tons/Week)
City A	101	59.2	103.7
City B	102	998.5	1389.7
City C	103	101.9	252.
City D	104	567.7	1301.3

In addition to sources and waste quantities, the computer must be given cost parameters for transportation and for the operation of the solid waste management system specified. Unit costs for the disposal systems tend to be lower as the quantities increase. Such variable cost factors are best described by cost curves which were incorporated into the computer input. These cost curves are shown in Figs. B-1 and B-2, Appendix B.

In developing the planning factors and cost curves, the consultant was faced with the problem of picking a finite value for a given function when, in actuality, that function could be described by a range of values. The values given here are neither the highest nor the lowest, but an estimate of current conditions. They were adjusted to 1973 cost levels using the Engineering News-Record construction cost index. Where appropriate, assumptions are listed.

Computations do not include the cost of solid waste collection. It is assumed that, regardless of the management system used, the waste must be collected. Whether it is collected once a week or twice a week, at the curb or at the back door, in plastic bags or in 32 gallon cans, are matters of local preference. The alternatives addressed in this study include the cost of moving from the centroid of the collection area to an intermediate or final disposal site.

Aside from taking the drudgery out of the thousands of calculations required, the computerized model permits the planners to examine a range of management alternatives. The strategies thus examined and reported here were proposed and analyzed by the regional planner with assistance from the State's consultants.

Resource Recovery

These analyses take a conservative view of the economics of resource recovery alternatives. As of March, 1974, there were no large scale resource recovery systems operating in the United States. Certain demonstrations projects are operating successfully in Franklin, Ohio and St. Louis, Missouri. Larger systems have been designed and several are under construction. We can

predict operating and capital costs better than we can predict the off-setting revenues from the sale of recoverable resources. Table 9 gives recent prices for the secondary materials present in typical municipal waste. These prices are subject to the usual variations of the commodities market, as well as regional variations in transportation costs. Table 10 describes eight levels of resource recovery activities and the expected revenue (based on Table 9 prices). The decision to adopt a resource recovery system will entail an evaluation of the risk involved in the fluctuating market values.

Uses of This Report

The results of this analysis are intended to assist the regional planner in preparing recommendations for local decision makers. The analytical techniques used are based upon averages and generalized planning factors developed in 1973 and cannot be expected to reflect the exact local cost situation. The usefulness of this regional analysis is to show the relative economic merits of alternate management systems, thus enabling the planner to separate the most feasible alternatives from the least feasible.

This report includes basic data, planning factors, and sample calculations so that the regional planner can make specific adjustments later on. It is to be emphasized that the least cost solution is not necessarily the best. The recommended solution will be that which combines economy with regional desires and constraints. To prepare such recommendations is the task of the regional planner.

Future Planning

It is expected that regional planners will need to up-date their plans and to consider other strategies. It is the intention of the Illinois Institute for Environmental Quality to maintain the capability for providing these regional analyses.

TABLE 9

RESOURCE RECOVERY VALUE FOR FERROUS AND NONFERROUS METALS, GLASS, FIBERS AND HEAT VALUE

Materials Recovered	Conc. In MSW (%)	Recovery (%)	T /100T MSW	Delivered Price	Trans. Charge (5)	Net Credit	Credit $/Ton Of Input Solid Waste
Ferrous Metal (6)	7.5	100	7.5	$56	$ 46	$11.7	$ .82
#2 Bundle	7.5	100	7.5	20 (10-30)	6	10	0.75
Madison (3)	7.5			51	6	14	1.05
Scrap Steel Jan. 73 (4)				86	6	45	
Jan. 74 (4)						80	
Scrap Steel				12 (10-14)	5	7 (5-9)	.53 (.40-.72) (.42 (6))
Incinerator Residue			7.5	200	50	150	1.50
Aluminum	1.0	100	1.	240	50	190	.95
Copper Zinc Fraction	.5	100	.5	860	50	810	
Copper Scrap (Jan. 73) (4)				1360	50	1310	
(Jan. 74) (4)				4000	50	3950	
Tin Scrap (Madison (3))				16	6	10	.40
Glass (Sorted by color)	9.	44	4.	5	6	- 1	-0.06
Mixed Glass Fines	9.	70	6.3	25	8	17	3.06
Fourth Forest Pulp (4)	40. (Dry Basis)	45	18.	18	8	10	0.80
Newsprint (July 73) (4)			8	35	8	27	2.16
(Nov. 73) (4) Separated			8	60	8	52	4.16
(Jan. 74)			8			15	2.25
Paper (6)			15.				
Energy Recovery							
Electric Energy (6)			6.67×10^4 Kwhr.			$.006/Kwhr.	4.00
Shredded Refuse Heat Value (7)			7.5×10^8 Btu/100 Ton			.50¢/M Btu	3.75
Total Combustible	75. (Wet Basis)	100	75.			(1.)	4.95
Combustible After						(2.)	3.3
Fiber Recovery	75. (Wet Basis)	66	50.			$.8-/10^6$ Btu	3.36
Synthetic Fuel Oil (6)			4.80×10^8 Btu/Ton			$.50/10^6$ Btu	3.33
Synthetic Fuel Gas (6)			6.7×10^8 Btu/Ton				3.33
Steam			175	1.90 @ .95/1000#			
			175				

1. Produces 450 Kilowatts-hours of Electricity/Ton, Valued at 1.1 Cent per Kilowatt-hours.
2. Producers 300 " " " " " " " " " " " "
3. From Madison Wisconsin Shredding and Landfill Operation.
4. Wall Street Journal - January 31, 1974
5. Transport Cost for 1973 Average Used Through-out, Value Fluctuates
6. Resource Recovery - The State of Technology, pg. 25
7. Commonwealth Edison 1974

This Table summarizes the by-product credits that may be realized by reclamation of recyclable materials from a ton of MSW. The credits reflect 1973 conditions and assume reasonable transportation charges to proximate recycling plants; i.e., the credits are based on delivered prices and representative concentrations of the salvaged materials in MSW. Extreme fluctuation can be seen in a one year period. Selection of appropriate value must be based on transport distance and market demand.

Table 10

TABLE OF RESOURCE RECOVERY VALUES FOR VARIOUS SYSTEMS

A. Small operation - magnetic separation of cans
$1.05/Ton of input Municipal Solid Waste (M.S.W.)

B. Cans and Paper Recovered
$1.05 Cans
3.06 Paper - based on separate collection
$4.11/Ton of input M.S.W.

C. Cans, Paper, Aluminum, Copper - Zinc Fraction Recovered
$1.05 Cans
3.06 Paper - separate collection
1.50 Aluminum
.95 Copper - Zinc Fraction
$6.56/Ton of input M.S.W.

D. Cans, Paper, Aluminum, Copper-Zinc, and Fraction Heat Recovery
$1.05/T for Cans
3.06/T for Paper separate collection
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
3.00/T for Heat Recovery after Fiber Recovery
$9.56/Ton M.S.W. Input

E. Incineration with Residue Recovery. Recover only Steel Cans
$ .53 Cans from incinerator Residue

$ .53/Ton M.S.W

F. Metal Recovery, Heat Recovery, Heat Recovery of Shredded M.S.W.
$1.05/T for Magnetic can separation
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
3.75/T for Shredded Fuel Value

$7.25/T of Input M.S.W.

G. Incineration with Residue Recovery and Heat Recovery
$ .53/T for Cans from incinerator Residue
1.50/T for Aluminum
.95/T for Copper-Zinc Fraction
4.50/T for Heat Value

$8.00/T for Heat and Material Recovery of M.S.W.

H. Source separation and separate collection of newsprint
$ .80-4.16/Ton of input Municipal Solid Waste (M.S.W.)

CAUTION: This table shows the value of recovered resources for 8 theoretical recovery systems. It is based on the "credit $/Ton" column of Table 9, and is subject to the conditions and assumptions stated. Tables 9 and 10 may need to be modified to reflect local markets and transportation costs.

SOLID WASTE MANAGEMENT FOR THE SOUTHEASTERN ILLINOIS REGION

The Southeastern Illinois region includes the counties of Gallatin, Hamilton, Hardin, Pope and Saline. The eastern portion of the region borders on White County and the Ohio and Wabash Rivers. The region has 7 cities with populations over 1,000 which contribute to the major waste loads. There are 60 municipal and township waste sources within the 5 county area. The Southeastern Illinois Regional Planning and Development Commission has provided data which shows that private collectors haul the refuse to 7 principal landfill sites. There are no public collection systems. Many individuals haul their own wastes to nearby disposal sites.

Most of the land in the region is part of the Shawnee National Forest. The land includes many former strip mine sites, which have a potential for becoming landfill sites or open dumps. The population in the rural areas is so sparse as to make it difficult to organize any kind of rural collection system. Because of the excellent recreational opportunities available, the region experiences peak tourist loads during the summer and the late fall deer hunting seasons.

Present Problem

The Southeastern Illinois region does not now have an adequate solid waste management system. The seven landfills indicated by the regional planners are small and therefore may be uneconomical and poorly managed. The Harrisburg landfill (Site 507), one of the principal facilities in the region, is expected to be filled in 1976 and some immediate decision is needed.

Computational Methods

Projections of population and employment were calculated using the method described in Chapter 1. The results are tabulated in Tables 1, 2 and 3 of Appendix A. A summary of geological information for the Southeastern Region (Appendix A) indicates soil and ground-

water conditions favorable for the use of sanitary landfills.

Short-term Analysis

Short-term planning solutions include those alternatives that could be reasonably expected to be operational within two to three years of plan acceptance. Each alternative analyzed is described by a separate diagram and summary sheet.

Alternative 1: Continue Existing System

The existing system is defined on the diagram as comprising 60 waste sources and 7 landfill sites. Based upon population and industrial activity, the waste load for the region (excluding sawmill waste) is approximately 784 tons/week (see Table A-3, Appendix A). The matching of waste sources with disposal sites has been made from data provided by the regional planning agency. Where no data was available, it has been assumed that waste goes to the nearest disposal site.

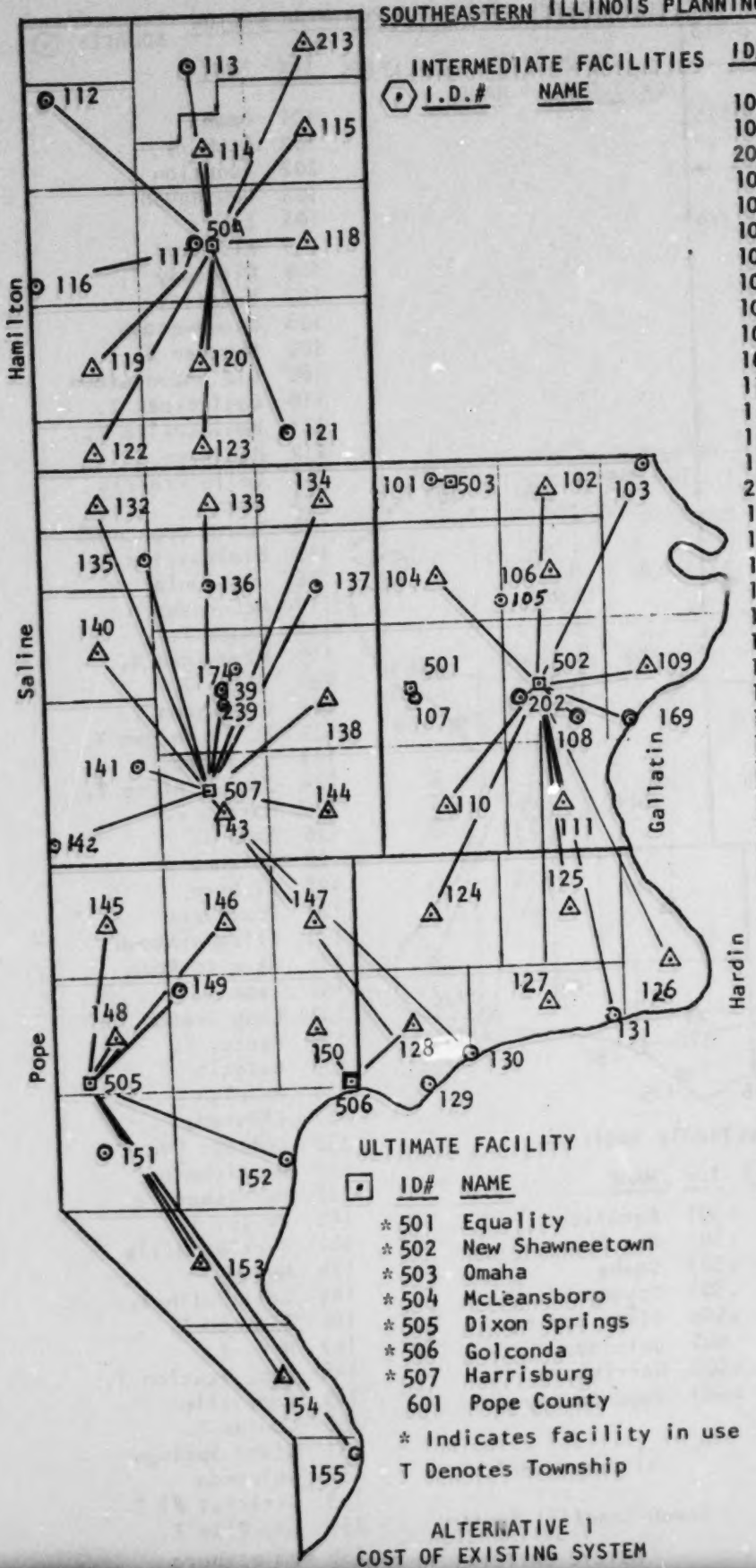
The total system unit cost ($8.22/ton) is remarkably low considering the high unit costs for the disposal facilities.

Alternative 2: Seven-Landfill System

At the time of this analysis, the Golconda site (506) had been closed and a State permit issued for a new Pope County Landfill (601). The redistribution of waste loads and the system cost are shown on the diagram and page 18. The 10% increase in cost shows the sensitivity of the analysis to changes in the haul pattern.

Alternative 3: Four-Landfill System

Landfill costs in Alternatives 1 and 2 are relatively high because of the small tonnage handled by each. A further



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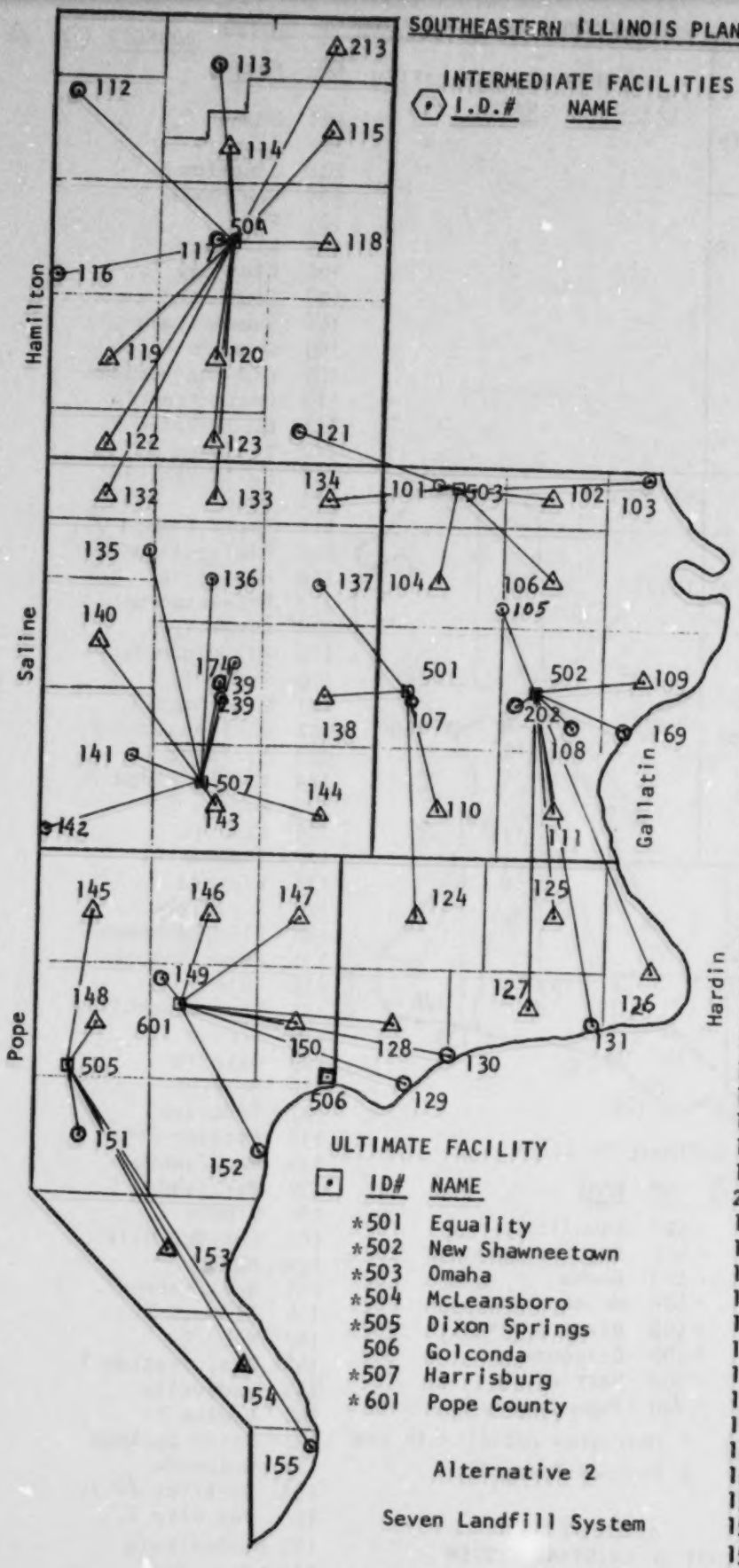
101	Omaha
102	Ashbury
202	Junction
103	New Haven
104	Elba
105	Ridgeway
106	Ridgeway T.
107	Equality
108	Shawneetown
109	Shawnee T.
169	Old Shawneetown
110	Eaglecreek T.
111	Bowlesville T.
112	Dahlgren
113	Belle Prairie
213	Aden
114	South Crouch T.
115	Blairsville T.
116	Macedonia
117	McLeansboro
118	Crook T.
119	Flannigan T.
120	Twigg T.
121	Broughton T.
122	S. Flannigan T.
123	S. Twigg T.
124	Karber Ridge T.
125	Harris T.
126	Lamb T.
127	Shawnee A.
128	Eichorn
129	Rosiclare
130	Elizabethtown
131	Cave-In-Rock
132	Tate T.
133	Long Branch T.
134	Rector T.
135	Galatia
136	Raleigh
137	Eldorado
138	Cottage Grove T.
139	Harrisburg 1
239	Harrisburg 2
140	Brushy T.
141	Carrier Mills
174	Muddy
145	Bell Smith T.
146	Jellwood T.
147	N.E. T.
148	Exp. Station T.
149	Eddyville
150	Gowins T.
151	Dixon Springs
152	Golconda
153	District #1 T.
154	Bay City T.
155	Hamletsburg
142	Stonefort



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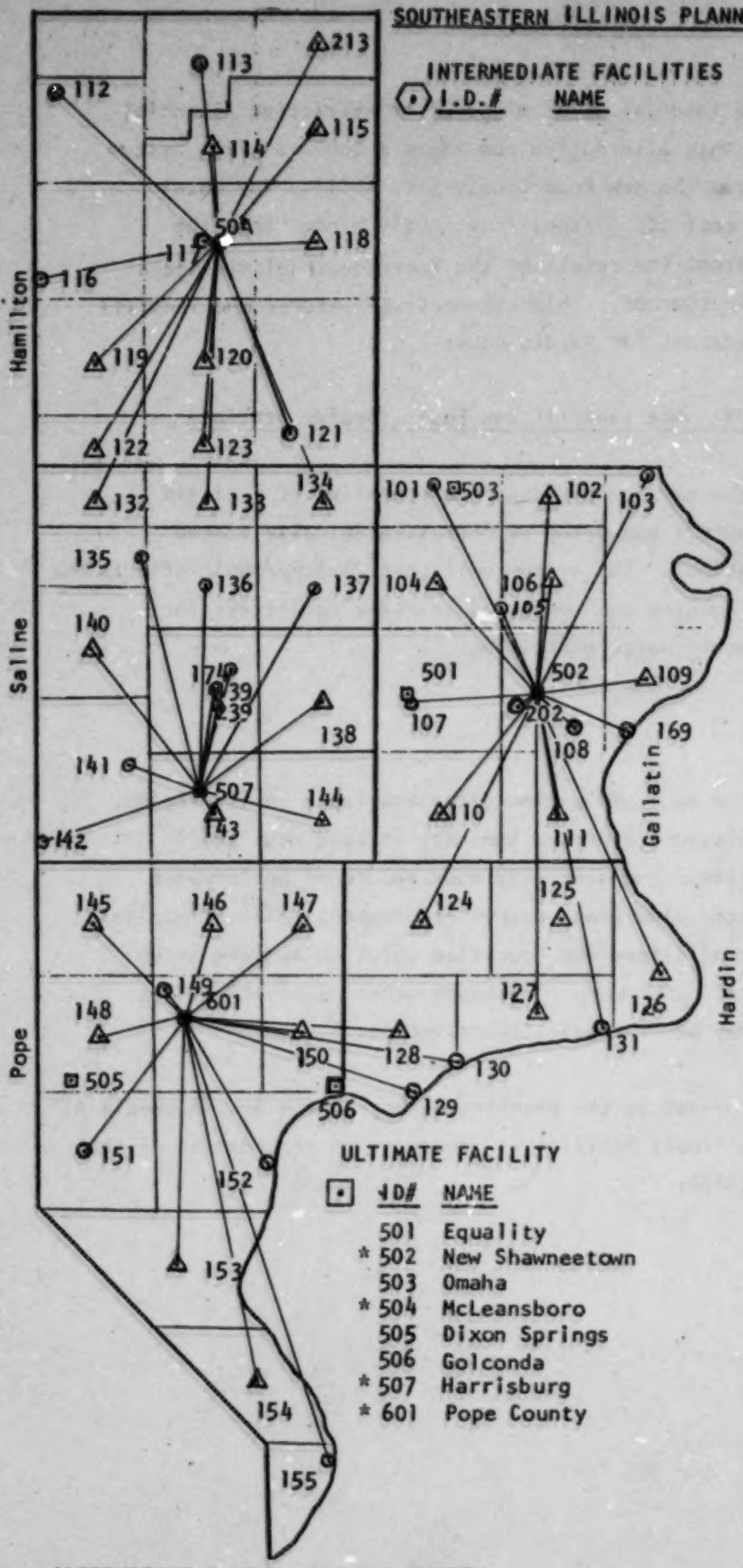
106	Ridgeway T.
107	Equality
108	Shawneetown
109	Shawnee T.
169	Old Shawneetown
110	Eaglecreek T.
111	Bowlesville T.
112	Dahlgren
113	Belle Prairie
213	Aden
114	South Crouch T.
115	Blairsville T.
116	Macedonia
117	McLeansboro
118	Crook T.
119	Flannigan T.
120	Twigg T.
121	Broughton T.
122	S. Flannigan T.
123	S. Twigg T.
124	Karber Ridge T.
125	Harris T.
126	Lamb T.
127	Shawnee A.
128	Eichorn
129	Rosiclare
130	Elizabethtown
131	Cave-In-Rock
132	Tate T.
133	Long Branch T.
134	Rector T.
135	Galatia
136	Raleigh
137	Eldorado
138	Cottage Grove T.
139	Harrisburg 1
239	Harrisburg 2
140	Brushy T.
141	Carrier Mills
174	Muddy
145	Bell Smith T.
146	Jellwood T.
147	N.E. T.
148	Exp. Station T.
149	Eddyville
150	Gowins T.
151	Dixon Springs
152	Golconda
153	District #1 T.
154	Bay City T.
155	Hamletsburg
142	Stonefort
143	Independance
144	Mountain



ID#	NAME
101	Omaha
102	Ashbury
202	Junction
103	New Haven
104	Elba
105	Ridgeway
106	Ridgeway T.
107	Equality
108	Shawneetown
109	Shawnee T.
169	Old Shawneetown
110	Eaglecreek T.
111	Bowlesville T.
112	Dahlgren
113	Belle Prairie
213	Aden
114	South Crouch T.
115	Blairsville T.
116	Macedonia
117	McLeansboro
118	Crook T.
119	Flannigan T.
120	Twigg T.
121	Broughton T.
122	S. Flannigan T.
123	S. Twigg T.
124	Karber Ridge T.
125	Harris T.
126	Lamb T.
127	Shawnee A.
128	Eichorn
129	Rosiclare
130	Elizabethtown
131	Cave-In-Rock
132	Tate T.
133	Long Branch T.
134	Rector T.
135	Galatia
136	Raleigh
137	Eldorado
138	Cottage Grove T.
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140	Brushy T.
141	Carrier Mills
174	Muddy
145	Bell Smith T.
146	Jellwood T.
147	N.E. T.
148	Exp. Station T.
149	Eddyville
150	Gowins T.
151	Dixon Springs
152	Golconda
153	District #1 T.
154	Bay City T.
155	Hamletsburg
142	Stonefort
143	Independance
144	Mountain

ALTERNATIVE 3 FOUR LANDFILL SYSTEM

reduction in landfill sites might offer attractive financial advantages. This alternative considers a four-landfill system which includes the new Pope County site (601). The total system unit cost ($8.57/ton) is slightly higher than the existing system, the result of the increased haul distances for the waste sources. This alternative features one landfill per county (except for Hardin County).

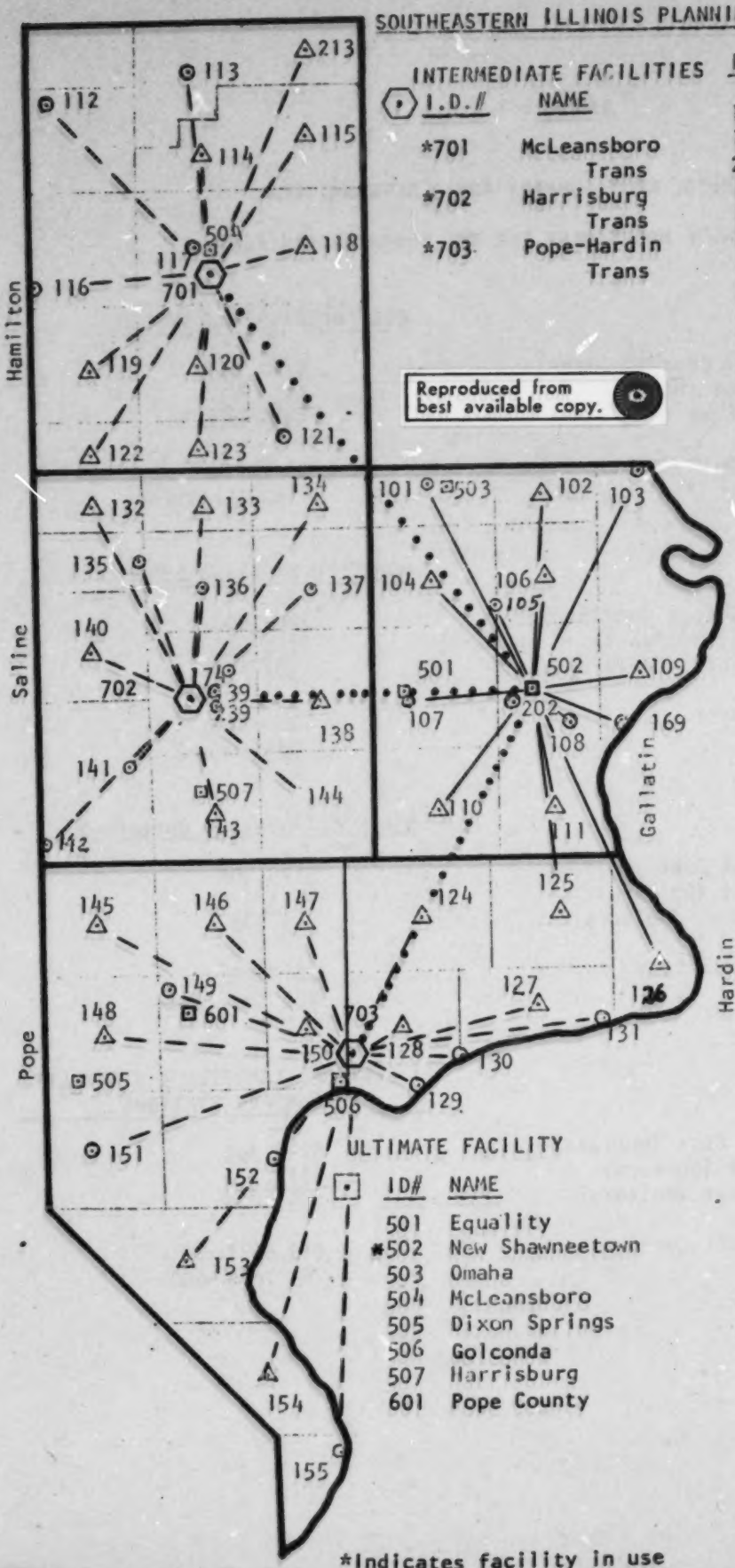
Alternative 4: One Landfill and Four Transfer Stations

This alternative considers the potential of a single regional landfill supported by four strategically placed transfer stations. The system unit cost ($13.66/ton) reflects the high cost of owning and operating transfer facilities for relatively small waste quantities.

Summary

Because of the many strip mine sites available in the region, the planning commission reports a tendency to have many small convenient landfills. The generally poor record of performance of these small sites plus State permit requirements will effectively reduce the number of sites. The four-site solution appears to be the most economical solution, although other alternatives not considered here may be of equal attractiveness.

From data provided by the planning agency (Table A-4, Appendix A) it appears that a timely decision is needed as to replacement of the Harrisburg site (507).



ID#	NAME
101	Omaha
102	Ashbury
202	Junction
103	New Haven
104	Elba
105	Ridgeway
106	Ridgeway T.
107	Equality
108	Shawneetown
109	Shawnee T.
169	Old Shawneetown
110	Eaglecreek T.
111	Bowlesville T.
112	Dahlgren
113	Belle Prairie
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114	South Crouch T.
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118	Crook T.
119	Flannigan T.
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121	Broughton T.
122	S. Flannigan T.
123	S. Twigg T.
124	Karber Ridge T.
125	Harris T.
126	Lamb T.
127	Shawnee A.
128	Eichorn
129	Rosiclare
130	Elizabethtown
131	Cave-In-Rock
132	Tate T.
133	Long Branch T.
134	Rector T.
135	Galatia
136	Raleigh
137	Eldorado
138	Cottage Grove T.
139	Harrisburg 1
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140	Brushy T.
141	Carrier Mills
174	Muddy
145	Bell Smith T.
146	Jellwood T.
147	N.E. T.
148	Exp. Station T.
149	Eddyville
150	Gowins T.
151	Dixon Springs
152	Golconda
153	District #1 T.
154	Bay City T.
155	Hamletsburg
142	Stonefort
143	Independance

TABLE 2-1

GENERAL COST SUMMARY FOR 4 ALTERNATIVES

TO SOLID WASTE MANAGEMENT FOR THE SOUTHEASTERN REGION

ALTERNATIVE 1	COST OF EXISTING SYSTEM
Total Facility Annual Cost (Dollars)	$182,950
Total System Haul Cost (Dollars)	$151,937
Total System Annual Cost (Dollars)	$334,887
Total System Annual Unit Cost	$8.22/Ton
Tonnage Handled	784 Tons/Week

ALTERNATIVE 2	MODIFIED EXISTING SYSTEM
Total Facility Annual Cost (Dollars)	$206,000
Total System Haul Cost (Dollars)	$161,050
Total System Annual Cost (Dollars)	$367,050
Total System Annual Unit Cost	$9.00/Ton
Tonnage Handled	784 Tons/Week

ALTERNATIVE 3	4 Landfill System Optimized
Total Facility Annual Cost (Dollars)	$175,000
Total System Haul Cost (Dollars)	$174,570
Total System Annual Cost (Dollars)	349,570
Total System Annual Unit Cost	$8.57/Ton
Tonnage Handled	784 Tons/Week

ALTERNATIVE 4	1 REGIONAL LANDFILL & 3 SATELITE TRANSFER STATIONS
Total Facility Annual Cost (Dollars)	$243,300
Total System Haul Cost (Dollars)	$313,720
Total System Annual Cost (Dollars)	$557,020
Total System Annual Unit Cost	$13.66/Ton
Tonnage Handled	784 Tons/Week

SOLID WASTE MANAGEMENT IN RECREATIONAL FOREST AREAS

Table 2-2 is an estimate of the waste generated in recreation areas located in the region (actual waste generation or collection factors for these areas are not available). Present waste loads are generated over a three or four month period, yielding approximately 57 tons/week, spread over the southern portion of the region.

TABLE 2-2

SOLID WASTE GENERATION FROM CAMPING AND RECREATIONAL ACTIVITIES FOR 1973*

Source	Campers ** lb/season	Visitors** lb/season	Total lb/season
Shawnee National Forest		276,000	276,000
Cave-In-Rock State Park	8,568	481,000	489,568
Dixon Springs State Park	5,922	239,000	244,922
Jones Lake	158,515	12,474	170,989
Old Shawneetown State Park	204	56,000	56,204
Dolans Lake	1,512	128,000	129,512
TOTAL			1,367,000 lb/season = 57 tons/wk. @ 12 wks./season

*Generation factors provided by US PHS Publication No. 1991, Solid Waste Management in Recreational Forest Areas

**Visitor and Camper numbers used to determine waste generation were supplied by Southeastern Planning Region.

The cost of haul and waste disposal for recreation areas should not be the full responsibility of local residents. State and Federal recreational funds should be sought. The seasonal load will decrease the life of the waste disposal facilities and will require changes in site maintenance and operation during the summer. Disposal of solid waste resulting from recreational activities will probably have little effect on the unit cost of disposal to the people in the Southeastern Region. However, a collection system for the recreational areas might also be of benefit to rural residents.

DESCRIPTION OF RURAL COLLECTION SYSTEM

The regionalization of solid waste management has more often than not led to the proposal of single landfills serving large areas of the countryside. The concentration of waste into disposal facilities reduces the unit operating costs of those facilities at the expense of increased haul costs.

Haul costs in rural regions tend to be high. Often the rural resident will haul his own waste to a disposal site, or will dispose of his waste on his own land. The inconvenience and cost of self-haul and self-disposal is great, and the chances are that such wastes will not be handled in an environmentally-acceptable manner.

To combine convenience and economy in rural areas, a system of strategically placed collection containers may be utilized. Although such a system must be paid for from general or "non-user" sources, the resultant system may be of sufficient overall value to warrant its use.

For purposes of evaluating the potential of this type of system, this report develops some of the costs and considerations using the Southeastern Illinois Region as an example.

The volume of waste considered in a rural container program excludes those identified sources having sufficient quantities and density to support a collection service (preferred by most citizens). The quantities considered below are county totals less those quantities derived from major sources.

Hamilton County	198 tons/week
McLeansboro	104 tons/week
Dahlgren	14 tons/week
Blairsville	14 tons/week
Broughton	11 tons/week
Rural	55 tons/week

	Saline County	397 tons/week
Less:	Harrisburg	174 tons/week
	Galatia	17 tons/week
	Raleigh	42 tons/week
	Eldorado	75 tons/week
	Carrier Mills	39 tons/week
	Rural	50 tons/week
	Pope County	68 tons/week
Less:	Golconda	18 tons/week
	Rural	50 tons/week
	Gallatin County	88 tons/week
Less:	Rideway	17 tons/week
	New Haven	12 tons/week
	Equality	13 tons/week
	Shawneetown	16 tons/week
		30 tons/week
	Hardin County	72 tons/week
	Rosiclare	26 tons/week
	Rural	46 tons/week
	Total Rural Waste	231 tons/week

The placement and capacity of rural containers is quite dependent upon population density, although in these rural areas the distance between residences may be the more important factor.

For purposes of discussion, this plan selects 6 cu.yd. containers with covers for placement throughout the rural areas. Actual placement locations initially will be determined from USDA aerial photos for the latest year available. Multiple container installations will be installed where the anticipated waste contribution warrants extra capacity. Full containers, unemptied will lead to litter, disuse,

and vandalism (fire etc.). Container capacities will be estimated as follows:

Loose waste weighs 175 to 225 pounds per cubic yard, therefore a 6 cu.yard container may hold 1050 to 1350 pounds when full. To provide adequate volume all containers are estimated to receive up to 80% capacity between collections.

Sample: 6 c.y. x 200 pounds/c.y. x 0.80 = 960 pounds or for convenience, 1000 pounds or 0.5 tons.

A container which is emptied twice a week will then optimally provide storage for 1 ton each week. Using the county calculations above, a minimum of 231 containers may be sufficient.

If each of the containers is serviced twice a week, 462 stops must be made by the service truck or trucks. While an estimated 10% of the containers may be at dual-container locations, servicing time will be comparable, only driving or hauling time will be reduced.

Servicing time averaging 5 minutes per container, including litter retrieval, is possible with a two-man crew. Front-end loading vehicles could reduce the crew size, however, the driver or another crew would have to maintain the sites, adding somewhat to the costs.

Considering the "frost rules" on rural highways during late winter and early spring, lighter trucks may be necessary. Waste collection would be as follows:

Per Vehicle -- annual cost

1 - 20 c.y. overhead loading truck $30,000

amortization @ 10% interest for 5 years

.2638 x 30,000 = $7914.00

Insurance = $550.00

Drivers wages 52 x 40 x 5.70 = $11,856.00

Helper (estimate ½ time for clean-up, etc.)

½ x 52 x 40 x 4.00 = $ 4,160.00

Fuel, Tires and Maintenance = $ 7,500.00

Total Annual Cost $31,980.00

@ 5 days per week 8 hours per day - 52 weeks per year

$31980 ÷ 2080 hours/year = $15.38/hr.

At an average rural road speed of 25 mph, one truck may, on route, consume approximately 15 minutes traveling an estimated six miles between containers.

5 min. pick up

15 min. between pick up

20 min. per container

Each container holds 1000 pounds or the equivalent of 2 cubic yards compacted in the collection vehicle. Twenty stops are then the maximum vehicle capacity.

If the routes commence at a landfill and terminate at the same location thus reducing time getting to and from sites, and the routes are designed to be continuous and convenient, as many as $\frac{480}{20}$ or 24 containers can be serviced in one day. Allowing for landfill turn around time of 20 minutes and other wasted time, such as coffee breaks, and circuitous routing, 18 containers are estimated to be maximum for servicing.

Therefore 18 containers or 9 tons per day will cost 8 x $15.38÷ 9=$13.67 per ton -- exclusive of pad construction (for container locations) management, or disposal costs.

The region would require no less than 462 stops ÷ 5 days = 92.4 stops per day or $\frac{92.4}{18.}$ = 5.13 trucks (using 6 trucks minimum to provide for maintenance back-up, etc.)

The summary cost of the collection alternative would be as follows:

5 trucks - 20 cy front-end loading vehicles

5 drivers $13.67 ton

5 helpers (½ time)

231 - 6 cu yd container @ $500 each
estimated life 8 years

$\frac{231 \times \$500}{8 \times 231 \times 52}$ = $1.20 ton

210 + Pads for container locations @ $15.00 ea

$\frac{210 \times 15.00}{231 \times 52}$ $0.26 ton

231 tons per week to landfill@$4.00+/ton $4.00 ton

Estimated Cost as above (exclusive of supervision)=$19.13 ton

or a total cost of 231 x 52 x $19.13 = $229,789.55

or $\frac{229789.55}{50575}$ = $4.54 per capita/year.

(3 persons per family)= $\frac{3 \times 4.54}{12}$ = $1.14 /month/family

Obviously the above calculations are estimates of cost for routes which have not been established or tested. The assumption that these routes can and would be established and maintained makes this a "least cost" estimate. From experience in other states, such a system requires considerable balancing of routes, sites and waste loads.

The container system described costs only about one-fourth as much as a once-a-week "mailbox" collection system. Rural container systems are becoming increasingly popular because of the low cost and proven effectiveness. The added advantage in this region is the accessibility of the system to tourists and the opportunity for cost sharing between federal, state, and local governments.

SUMMARY

1. The originally proposed 4 landfill system seems to be appropriate to the Southeastern Illinois Region.

2. Conveniently located rural containers could provide more service to all residents of the region at a cost of slightly more than one dollar per month per family ($1.14).

3. The utilization of the area by tourists and campers may justify state or federal support for the added expense of convenience. The reduced cost of litter control may well off-set any costs incurred as result of the project.

Further work is required to ascertain local conditions of which the local planners have knowledge. In this study, waste quantities are generation quantities and are not necessarily the quantities that are being collected or are appearing at landfill sites. Where collection service is limited, much of the waste may be going to promiscuous dumping sites. The effects of the recreational activities would fit in well with the public usefulness of a containerized collection system. The impact of industrial wastes on the system is uncertain. Officials of the region have already shown considerable ingenuity in reducing the cost of landfill operations. This same local knowledge might also improve the container collection system.

Use of This Study

Many citizens of this region have no solid waste collection, haul or disposal service. They will not be easily convinced of the need for better-managed system described here. They must be convinced that directly or indirectly they are paying the price for solid waste management.

One approach to this problem is to evaluate the hidden costs of inadequate solid waste management practices. The convenience and the saving in time and transportation costs for self-hauling to the traditional disposal site are obvious, and will become more evident when many of the small landfills close in response to State environmental regulations.

A more pertinent argument can be made from the fact that it is the rural landowner who generally pays for inadequate solid waste management systems which lead to promiscuous dumping on his land or along the roads which serve his property. The aggravation, the possible land devaluation, and the legal liabilities of having an open dump on his property are real costs to the landowner. The road maintenance funds spent on trash pickup have been estimated by one study at $50 per ton. The diversion of road funds can only result in less road maintenance, a further cost and inconvenience to the rural landowners. In either case, part of the rural property tax dollar will be used for the disposal of solid waste.

For an important recreation area such as this region, the solid waste system will have an important impact on the use and enjoyment of the environment by

tourists and residents alike.

This study is intended for the regional planning officials whose job is to work with local elected officials to find ways to meet local needs. The alternatives show the comparative economics of several management systems. The elected officials must find the way to show the public that the most equitable system is one in which everyone participates. Planners and engineers who have need to up-date or modify these alternatives may obtain assistance from the Illinois Institute for Environmental Quality.

APPENDIX A

Southeastern Illinois Region	Page
1. Geological Information	A-1
2. Population Projections-Table A-1	A-6
3. Employment Projections-Table A-2	A-9
4. Total Solid Waste Quantities Table A-3	A-15
5. Crisis and Decision Dates for Southeastern Illinois Region Table A-4	A-16

GALLATIN

Type of Bedrock: Mainly shale, some water yielding limestone and sandstone.
Drift Thickness: Southeastern half - driftless, northwestern - 50 to 200 ft.
Type of Material: Eastern - outwash and alluvium, Western - lake deposits.
Glacial Aquifers: Absent.
Sand and Gravel Aquifers: North Eastern portion extensive, remaining area rare to extensive.
Limestone Aquifers: Absent.
Sandstone Aquifers: Possibly present.

The bedrock is composed of mainly shale with some water-yielding sandstone and limestone. There appears to be a buried bedrock valley in the County, and consideration should be given to a fault in the southern part of the County. Glacial drift is found in only the northwestern portion as the Illinoian glacier extended only to the northwestern area. In this section, drift may be from 0 to 200 ft. deep. The characteristics of the drift are that outwash and alluvium, lake deposits and till can all be found here. An 8 ft. layer of loess is found in the area. Along the Wabash River, an extensive number of sand and gravel aquifers are located. Also along the Saline River, scattered aquifer can be found. Sandstone, but no limestone aquifers are found throughout the area.

By combining the bedrock and the unconsolidated layers potential, a moderate level of contamination exists for most of the county. Driftless or minimum depth drift conditions provide little protection for the ground water. The central north portion affords the most protection, but site specific information is required to insured adequate protection of the water resource.

Geological Information

HAMILTON

Type of Bedrock:	Mainly shale with water-yielding sandstone and limestone
Drift Thickness:	Less than 50 ft., with an area of 50 to 200 ft. along Skillet Fork Creek
Type of Drift Mtl:	Lake deposits with till
Glacial Aquifers:	Absent
S & G Aquifers:	Rare in most areas, scattered along Skillet Fork and North Fork Creeks
Limestone Aquifers:	Absent
Sandstone Aquifers:	Possible presents

Shale with some sandstone and limestone composes the bedrock of this county. The present day surface waters coincide with the bedrock river valleys. A 50 to 200 ft. layer of drift can be found in the northeast and southeast corners of the county, as the remainder of the area has less than 50 ft. of drift, and some areas of exposed bedrock. The drift material found in the area includes outwash and alluvium along the creeks with till over the remaining area. 4 ft. of loess serves as cover material. Scattered sand and gravel aquifers coincide with the location of the stream beds, but are found rarely in the remainder of the county. Sandstone, but no limestone aquifers are to be expected in the area.

The areas which have a thick layer of lake deposit material, have a moderate to high potential contamination problem of the unconsolidated aquifers as the material is very permeable. Other areas, with a thin layer of drift have a moderate possibility of contaminating the bedrock aquifers. By combining these problems, almost the entire county shows a limited amount of natural protection for landfilling. Landfilling operations may require man-made barriers to protect the groundwaters.

Geological Information

HARDIN

Type of Bedrock:	North - Shale, sandstone, limestone, South - water yielding limestone and sandstone.
Drift Thickness:	Driftless
Type of Drift Mtl:	Outwash and alluvium
Glacial Aquifers:	Absent
S & G Aquifers:	Absent
Limestone Aquifers:	Absent
Sandstone Aquifers:	Absent

The bedrock in the South half is water yielding limestone and sandstone. In the Northern portion the bedrock is mainly shale. Driftless condition exist, but some till and lake deposits are present. In this county's bedrock, 4 fault lines exist which may be a problem. No sand and gravel, or limestone aquifers exist in the county, but sandstone aquifers are prevalent in the northern portion.

Limited drift protection results in a high potential level for contamination of the bedrock aquifers as the bedrock may be exposed to the surface contaminants.

Geological Information

POPE

Type of Bedrock:	Southwest - water-yielding sand, center - limestone and sandstone, some shale
Drift Thickness:	Driftless
Type of Drift Mtl:	Outwash and alluvium, lake deposits, till
Glacial Aquifers:	Absent
S & G Aquifers:	Possibly present
Limestone Aquifers:	Absent
Sandstone Aquifers:	Possibly present

Water-yielding sands are the bedrock in southeastern area, whereas the majority of the area has limestone and sandstone. Some shale can be found in the northern portion. Three fault lines cross this county which cause abrupt changes in the bedrock. The area is south of the glacial movement, but lake deposits, outwash and alluvium, till can be found in the area. An extensive band of sand and gravel aquifers crosses the central area and the southern tip, while found rarely otherwise. No limestone, but sandstone aquifers are also present in the area.

The potential for contamination of the unconsolidated layer aquifers is moderate to high in the southern portion due to the presence of such aquifers in the county. With little or no drift material as protection, the potential for contamination of the bedrock aquifers is high to moderate for the majority of the area.

Geological Information

SALINE

Type of Bedrock:	Mainly shale with some water-yielding sandstone and limestone
Drift Thickness:	Driftless, - southern part, central and northeast 50 to 200 ft.
Type of Drift Mtl:	Lake deposits and till
Glacial Aquifers:	Absent
S & G Aquifers:	Scattered in the northeast and southeast
Limestone Aquifers:	Absent
Sandstone Aquifers:	Possibly present

Mainly shale, some permeable sandstone, and limestone are the major constituents of the bedrock in this county. The Illinoian glacier stopped about the middle of the county leaving driftless conditions to the south and less than 50 ft. of drift to more than 50 ft. of drift to the north. The drift is composed of lake deposits and till and has an 8 ft. deep layer of loess. Sandstone, but no limestone aquifers may be present in the area.

The potential for contamination of the bedrock aquifer is low for almost the entire county, but the potential for contamination of the unconsolidated aquifers is moderate to high for most of the county.

Table A-1-1

SOUTHEASTERN ILLINOIS REGION

PROJECTED POPULATION FOR

GALLATIN COUNTY

Location	1970*	1975	1980	1985	1990	1995	2000
Incorporated							
Equality	732	740	770	810	860	870	890
Junction	199	210	210	220	230	230	230
New Haven	606	700	740	800	860	890	930
Old Shawneetown	342	350	340	340	330	320	300
Omaha	304	320	330	350	370	370	380
Ridgway	1160	1290	1400	1560	1730	1850	1960
Shawneetown	1742	1700	1790	1930	2070	2130	2200
Sub Total	5085	5350	5610	6050	6480	6700	6910
Unincorporated	2333	2200	2010	1890	1760	1580	1420
County Total **	7418	7550	7630	7940	8240	8290	8330

Table A-1-2

PROJECTED POPULATION FOR

HAMILTON COUNTY

Location	1970*	1975	1980	1985	1990	1995	2000
Incorporated							
Belle Pr City	52	63	63	65	67	68	70
Broughton	235	210	200	190	190	180	180
Dahlgren	487	480	480	490	500	510	520
Mc Leansboro	2630	2980	3130	3370	3610	3860	4110
Macedonia	62	55	53	51	49	47	46
Sub Total	3466	3800	3930	4180	4430	4680	4930
Unincorporated	5199	4910	4620	4460	4300	4130	3950
County Total **	8665	8710	8560	8650	8730	8810	8890

*Census Data Report P C(V1) -15 January 1971

** Summations performed prior to rounding off

Table A-1-3

PROJECTED POPULATION FOR

HARDIN COUNTY

Location	1970*	1975	1980	1985	1990	1995	2000
Incorporated							
Cave-In-Rock	503	530	580	620	660	710	750
Elizabethtown	436	440	450	460	460	460	460
Rosiclare	1421	1530	1590	1630	1680	1700	1730
Sub Total	2360	2510	2620	2720	2820	2880	2950
Unincorporated	2554	2430	2350	2260	2180	2070	1960
County Total **	4914	4950	4980	4990	5000	4960	4920

Table A-1-4

PROJECTED POPULATION FOR

POPE COUNTY

Location	1970*	1975	1980	1985	1990	1995	2000
Incorporated							
Eddyville	127	140	160	170	190	210	230
Golconda	922	970	1030	1070	1110	1150	1190
Hamletsburg	79	83	81	77	74	71	67
Sub Total	1128	1200	1270	1330	1380	1440	1490
Unincorporated	2729	2640	2570	2470	2370	2260	2150
County Total **	3857	3850	3850	3800	3760	3700	3640

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* Census Data Report P C (VI) -15 January 1971

** Summations performed prior to rounding off

Table A-1-5

PROJECTED POPULATION FOR

SALINE COUNTY

Location	1970*	1975	1980	1985	1990	1995	2000
Incorporated							
Carrier Mills	2013	2180	2320	2490	2650	2820	2990
Eldorado	3876	3970	4150	4370	4580	4790	4990
Galatia	792	860	910	960	1020	1070	1130
Harrisburg	9535	10100	10700	11300	12000	12700	13300
Muddy	109	130	150	170	200	230	270
Raleigh	215	190	180	170	170	160	150
Stonefort	147	140	140	140	130	130	130
Sub Total	16687	17600	18500	19600	20800	21900	23000
Unincorporated	9034	8830	8620	8450	8270	8060	7850
County Total**	25721	26400	27200	28100	29000	30000	30900

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* Census Data Report P C (V1)-15 January 1971

** Summations performed prior to Rounding Off

Table A-2-1

PROJECTED EMPLOYMENT FOR

SOUTHEASTERN ILLINOIS PLANNING REGION

FOR SIC CODES FOUND IN APPENDIX B

GALLATIN COUNTY TOTAL

SIC	1971	1975	1980	1985	1990	1995	2000
204	18	10	5	2	1	0	0
209	74	73	71	70	68	66	65
2421	39	58	79	98	110	130	150
251	199	190	190	180	180	170	170
346	24	37	54	70	85	100	110

PROJECTED EMPLOYMENT FOR

OMAHA

SIC	1971	1975	1980	1985	1990	1995	2000
204	7	5	3	1	0	0	0

PROJECTED EMPLOYMENT FOR

RIDGWAY

SIC	1971	1975	1980	1985	1990	1995	2000
204	12	4	1	0	0	0	0
209	75	73	71	69	67	65	65
2421	40	58	78	97	110	120	140
352	4	3	3	3	3	3	3

PROJECTED EMPLOYMENT FOR

SHAWNEETOWN

SIC	1971	1975	1980	1985	1990	1995	2000
251	200	180	190	170	180	170	160
346	25	36	53	70	85	99	110

Table A-2-2

PROJECTED EMPLOYMENT FOR

SOUTHEASTERN ILLINOIS PLANNING REGION

FOR SIC CODES FOUND IN APPENDIX B

Hamilton County Total

SIC	1971	1975	1980	1985	1990	1995	2000
204	5	8	10	13	16	18	21
232	259	230	210	190	170	150	140
2421	3	2	1	0	0	0	0
244	29	30	31	32	32	33	33
271	7	8	8	8	8	8	8
291	5	6	6	6	6	6	6
335	4	5	5	5	5	5	5
349*	14	15	15	16	16	16	16

PROJECTED EMPLOYMENT FOR

MC LEANSBORO

SIC	1971	1975	1980	1985	1990	1995	2000
204	4	8	11	11	21	0	0
232	260	220	200	180	170	150	130
2421	4	1	0	0	0	0	0
244	30	30	31	32	32	33	33
271	8	8	8	8	8	8	8
291	6	6	6	6	6	6	6
335	5	5	5	5	5	5	5
349*	15	15	15	16	16	16	16

Table A-2-3

PROJECTED EMPLOYMENT FOR

SOUTHEASTERN ILLINOIS PLANNING REGION

FOR SIC CODES FOUND IN APPENDIX B

Hardin County Total

SIC	1971	1975	1980	1985	1990	1995	2000
243*	6	9	12	13	15	16	17
273	7	11	13	15	17	18	19
289*	4	7	8	9	10	11	12
328	15	30	51	74	100	120	150

PROJECTED EMPLOYMENT FOR

CAVE IN ROCK

SIC	1971	1975	1980	1985	1990	1995	2000
328	15	14	24	35	46	55	69
329	19	26	32	37	41	44	46

PROJECTED EMPLOYMENT FOR

ELIZABETHTOWN

SIC	1971	1975	1980	1985	1990	1995	2000
243*	7	9	12	13	15	16	17
273	8	11	13	15	17	18	19
289*	5	7	8	9	10	11	12

PROJECTED EMPLOYMENT FOR

ROSICLARE

SIC	1971	1975	1980	1985	1990	1995	2000
328	16	15	27	39	53	64	80

Table A-2-4

PROJECTED EMPLOYMENT FOR

SOUTHEASTERN ILLINOIS PLANNING REGION

FOR SIC CODES FOUND IN APPENDIX B

Pope County Total

SIC	1971	1975	1980	1985	1990	1995	2000
271	2	1	1	1	1	1	1

PROJECTED EMPLOYMENT FOR

GOLCONDA

SIC	1971	1975	1980	1985	1990	1995	2000
271	2	1	1	1	1	1	1

Table A-2-5

PROJECTED EMPLOYMENT FOR

SOUTHEASTERN ILLINOIS PLANNING REGION

FOR SIC CODES FOUND IN APPENDIX B

Saline County Total

SIC	1971	1975	1980	1985	1990	1995	2000
201	22	23	23	23	22	22	21
202*	69	75	56	41	30	22	16
205	5	6	6	6	6	5	5
208	9	11	12	12	14	15	15
209	2	3	3	3	3	2	2
243*	4	5	5	5	5	4	4
254	24	25	25	25	24	24	23
264	179	210	240	270	300	330	350
271	49	58	63	68	72	76	79
275	2	1	0	0	0	0	0
287	19	20	20	19	19	18	18
323	24	25	25	25	24	24	23
327*	16	17	17	17	16	16	16
328	2	3	3	3	3	3	3
344	1	2	2	2	2	2	2
354	4	5	5	5	5	4	4
359	19	16	13	10	8	7	5

PROJECTED EMPLOYMENT FOR

Eldorado

SIC	1971	1975	1980	1985	1990	1995	2000
205	6	6	6	6	6	5	5
271	8	13	18	23	26	30	33
287	20	20	20	19	18	17	17
323	25	25	25	25	24	24	23
328	3	3	3	3	3	3	3
344	2	0	0	0	0	0	0
359	20	15	12	10	8	6	5

Table A-2-5 (continued)

PROJECTED EMPLOYMENT FOR

Galatia

SIC	1971	1975	1980	1985	1990	1995	2000
243*	5	5	5	5	5	4	4

PROJECTED EMPLOYMENT FOR

Raleigh

SIC	1971	1975	1980	1985	1990	1995	2000
202*	70	75	55	41	29	22	16
208	10	10	11	12	13	15	15
209	3	3	3	3	3	2	2
254	25	25	25	25	24	24	23
264	180	210	240	260	290	320	350
271	42	44	44	45	45	45	45
275	3	0	0	0	0	0	0
327*	17	17	17	17	16	16	16
354	5	5	5	5	5	4	4

Table A-3

SOUTHEASTERN ILLINOIS REGION

STUDY PERIOD INVENTORY OF SOURCES AND QUANTITIES

Source I.D.#	Source Name	1973 Estimated Quantities (Tons/Week)	1993 Estimated Quantities (Tons/Week)
101	Omaha	6.	8
102	Ashbury T	2.	1
202	Junction	3.	5
103	New Haven	12.	24
104	Elba T	3.	3
105	Ridgway	340 (17)*	680 (36)*
106	Ridgeway Town	3.	3
107	Equality	13.	21
108	Shawneetown	16.	75
169	Old Shaneetown	5.	7
109	Shawnee T	2.	3
110	Eagle Greek T	3.	3
111	Bowlesville T	3.	4
112	Dahlgren	14.	20
113	Belle Prairie	7.	8
213	Aden A	1.	2
114	South Crouch	4.	5
115	Blairsville	14.	7
116	Macedonia	6.	8
117	McLeansboro	104.	125
118	Crook T	5.	7
119	Flanningan T	5.	7
120	Twigg T	6.	7
121	Broughton	11.	14
122	S. Flanningan T	3.	3
123	S. Twigg T	3.	3
124	Karber Ridge T	8.	11
125	Harris A	6.	8
126	Lamb A	4.	4
127.	Shawnee A	5.	5
128	Eichorn A	5.	7
129	Rosiclare	26.	48
130	Elizabethtown	8.	15
131	Cave-In-Rock	10.	28
132	Tate T	5.	8
133	Long Branch T	5.	8
134	Rector T	5.	8
135	Galatia	17.	29
136	Raleigh	42.	53
137	Eldorado	75.	131
138	Cottage Grove T	9.	14
239	Harrisburg 1	74.	120
139	Harrisburg 2	100.	219
140	Brushy T	10.	14
141	Carrier Mills	39.	15
142	Stonefort	7.	10
143	Independence T	10.	15
144	Mountain T	12.	17
174	Muddy	2.	4.3
145	Bell Smith A	1.	4.4
146	Jelwood	1.	4.4
147	Northeast A	1.	2.9
148	U of I-AG. EX. S	1.	4.4
149	Eddyville	2.	4.4
150	Gowins A	1.	2.9
151	Dixon Springs A	1.	4.4
152	Golconda	18.	5.3
153	District No 1	1.	6.3
154	Bay City	1.	6.3
155	Hamletsburg	1.	6.3
	COUNTY TOTAL -	1107. (784)*	1895. (1251)*

*INDICATES QUANTITY EXCLUDING SAWMILL WASTE

TABLE A-4

TABLE OF DECISION AND CRISIS DATES FOR SOUTHEASTERN ILLINOIS REGION

Alternative 1

Based on the present source-site pairing and the present predicted waste loads, the crisis and decision dates for the operating fill sites are as follows:

Facility Date	501	502	503	504	505	506	507	601
Crisis Date	1985	1990	1981	1992	1978	Now	1976	New Site
Decision Date	1982	1988	1979	1990	1976	Now	1974	

Alternative 2

Based on the source-site pairing and present predicted waste loads as specified in alternative 2 diagram. Dates of importance are as follows:

	501	502	503	504	507	601
Lifetime Years	1.	9.	50.*	1.	18.8	3.	New Site
Crisis Date	1975	1984	?	1975	1993	1977	? 3536 TPY
Division Date	Now	1982	?	Now	1991	1975	?

Alternative 3

This alternative has one landfill per county except for Hardin County which disposes of waste in both Pope and Gallatin. The dates are based on the present waste loads.

	502	504	507	601
Lifetime Years	8.	30.*	17	2.6	3536 TPY
Crisis Date	1983	?	1991	1976	
Division Date	1981		1989	1974	

Alternative 4

The dates reflect present loadings established in transfer system as indicated in the diagram.

	502	
Lifetime Years	3.4	4.7*
Crisis Date	1977	1978*
Division Date	1975	1976*

APPENDIX B

	Pages
1. Method for calculating municipal and industrial collection rates.	B-1
2. Industrial waste generation factors. Table B-1	B-3
3. Haul Cost Factor with assumptions. Table B-2	B-6
4. Cost Functions: Sanitary Landfill. Figure B-1	B-9
5. Basic Landfill Cost Assumptions For 50, 100, 250, 500, 1000, 2000, and 5000 tons/week. Tables B-3 to B-9	B-10
6. Cost Functions: Intermediate Processing Facilities. Figure B-2	B-18
7. Equations for Facility Cost Functions.	B-19
8. Resource Recovery Facility Description.	B-21
9. Resource Recovery Capital and Annual Cost. Table B-10	B-22

Municipal Generation Rates

The technique selected for estimating present generation rates was developed by Roy F. Weston, Inc. The technique involved the calculation of a generation rate factor which was then multiplied by the population to obtain the generation rate per week for a given geographic area. The generation factor is a function of the population density as shown in the following equations:

$$U = 1.54 \text{ Log } D - 0.68$$

$$V = U \times 7 \text{ day/week} \times 1 \text{ ton/2000 lbs.}$$

$$W = V \times \text{Population within the given area}$$

where: U = per capita waste generation rate in lbs/capita /day

D = population density in person/square miles

V = per capita waste generation rate in tons/capita/week

W = ton per week of waste generated within given area

This relationship is valid in the population density range of 500 - 12,000 persons/square mile. Below the lower limit of the range, the generation factor used is 3.4 lbs/capita/day; above the upper limit, the factor used is 5.6 lbs/capita/day.

Industrial Generation Rate

During the past few years, the Office of Solid Waste Management Programs has funded a number of industrial solid waste surveys to develop solid waste generation factors. A summary of these factors was used to develop industrial solid waste loads by SIC number. The following equation demonstrates the use of the generation factors.

$$I = G.F. \times \text{No. of Employees}$$

$$J = I \div 52$$

where I = yearly production rate in tons/year

G. F = generation factor in tons/employee/year

J = weekly production rate in tons/week

These relationships are used to estimate probable industrial waste loads, but the yearly employment fluctuation, and generation factors make adjustment necessary for specific locations and plants.

TABLE B-1

Industrial Solid Waste Generation Factors [8]

SIC No.	Name	Generation Factor (tons/employee/year)
201	Meat Products	14.1
2021	Creamery butter	33.0
2022	Cheese, Natural and Processed	169.1
202 (R)[1]	Dairy Products	2.2
203	Canned and Preserved Fruits, Vegetables and Sea Foods	5.4
204	Grain Mill Products	6.2
205	Bakery Products	1.2
206	Sugar	17.2
207	Confectionery and Related Products	3.3
208	Beverages	11.0
209	Miscellaneous Food Preparations and Kindred Products	0.8
211	Cigarettes	1.5
212	Cigars	3.1
213	Tobacco (Chewing and Smoking) and Snuff	0.2
214	Tobacco Stemming and Redrying	4.4
221	Broad Woven Fabric Mills, Cotton	0.4
222	Broad Woven Fabric Mills, Man-made Fiber and Silk	0.7
223	Broad Woven Fabric Mills	0.1
224	Narrow Fabrics and Other Small-wares Mills: Cotton, Wool, Silk and Man-made Fiber	1.2
225	Knitting Mills	1.3
226	Dyeing and Finishing Textiles, Except Wood Fabrics and Knit Goods	2.4
227	Floor Covering Mills	0.2
228	Yarn and Thread Mills	0.7
229	Miscellaneous Textile Goods	4.5
231	Men's, Youths', and Boys' Suits, Coats and Overcoats	0.3
232	Men's, Youths', and Boys' Furnishings, Work Clothing, and Allied Garments	0.3
233	Women's, Misses', and Juniors' Outerwear	0.9
234	Women's, Misses', Children's and Infants' Under Garments	0.4
235	Hats, Caps, and Millinery	0.2
236	Girls', Children's, and Infants' Outerwear	0.9
237	Fur Goods	0.5
238	Miscellaneous Apparel and Accessories	0.4
239	Miscellaneous-Fabricated Textile Products	0.4
241	Logging Camps and Logging Contractors	30.0
2421	Sawmills and planing mills, general	420.0
242 (R)[1]	Sawmills and planing mills	38.7
2432	Veneer and plywood	232.0
243 (R)[1]	Millwork, Veneer, Plywood, and Prefabricated Structural Wood Products	21.7
244	Wooden Containers	16.0
249	Miscellaneous Wood Products	43.0
251	Household Furniture	1.8
252	Office Furniture	2.6
253	Public Building and Related Furniture	1.8
254	Partitions, Shelving, Lockers, and Office and Store Fixtures	3.6
259	Miscellaneous Furniture and Fixtures	1.5
261	Pulp Mills	31.5
262	Paper Mills, Except Building Paper Mills	11.7
263	Paperboard Mills	11.5
264	Converted Paper and Paperboard Products, Except Containers and Boxes	4.0
265	Paperboard Containers and Boxes	12.6
266	Building Paper and Building Board Mills	103.0
271	Newspapers: Publishing, Publishing and Printing	1.1
272	Periodicals: Publishing, Publishing and Printing	0.1
273	Books	0.8
274	Miscellaneous Publishing	0.1
275	Commercial Printing	1.1
276	Manifold Business Forms	4.4
277	Greeting Card Publishing	1.2
278	Blankbooks, Loose Leaf Binders, and Bookbinding and Related Work	2.6
279	Service Industries for Printing Trade	1.4
2819	Industrial Inorganic Chemicals, not Elsewhere Classified	109.0
281 (R)[1]	Industrial Inorganic and Organic Chemicals	18.8
282	Plastics Materials and Synthetic Resins, Synthetic Rubber, Synthetic and Other Man-Made Fibers, Except Glass	16.2

TABLE B-1

Industrial Waste Generation Factors (Continued)

SIC No.	Name	Generation Factor (tons/employee/year)
283	Drugs	3.4
284	Soap, Detergents, and Cleaning Preparations, Perfumes, Cosmetics, and Other Toilet Preparations	3.3
285	Paints, Varnishes, Lacquers, Enamels, and Allied Products	6.2
286	Gum and Wood Chemicals	0.1
287	Agricultural Chemicals	13.5
2891	Adhesives and gelatin	39.4
289 (R)[1]	Miscellaneous Chemical Products	1.2
291	Petroleum Refining	30.6
295	Paving and Roofing Materials	0.9
299	Miscellaneous Products of Petroleum and Coal	9.3
301	Tires and Inner Tubes	3.7
302	Rubber Footwear	2.1
303	Reclaimed Rubber	2.4
306	Fabricated Rubber Products, Not Classified Elsewhere	2.5
307	Miscellaneous Plastics Products	1.3
311	Leather Tanning and Finishing	2.3
312	Industrial Leather Belting and Packing	0.8
313	Boot and Shoe Cut Stock and Findings	1.8
314	Footwear, Except Rubber	0.4
315	Leather Gloves and Mittens	1.3
316	Luggage	7.0
317	Handbags and Other Personal Leather Goods	0.4
319	Leather Goods, Not Elsewhere Classified	0.5
321	Flat Glass	2.5
322	Glass and Glassware, Pressed or Blown	1.4
323	Glass Products, Made of Purchased Glass	1.8
324	Cement, Hydraulic	8.8
325	Structural Clay Products	1.7
326	Pottery and Related Products	3.6
3272	Concrete products, except block and brick	154.0
327 (R)[1]	Concrete, Gypsum, and Plaster Products	15.0
328	Cut Stone and Stone Products	4.2
329	Abrasive, Asbestos, and Miscellaneous Nonmetallic Mineral Products	5.2
3312	Blast Furnaces (Including coke ovens), Steel Works, and Rolling Mills	130.0
331 (R)[1]	Blast furnaces, Steel Works, and Rolling and Finishing Mills	3.4
3321	Gray Iron foundries	100.0
332 (R)[1]	Iron and Steel Foundries	20.0
3334	Primary production of aluminum	58.0
333 (R)[1]	Primary Smelting and Refining of Nonferrous Metals	2.5
334	Secondary Smelting and Refining of Nonferrous Metals	103.0
335	Rolling, Drawing and Extruding of Nonferrous Metals	5.3
336	Nonferrous Foundries	2.7
339	Miscellaneous Primary Metal Products	2.0
341	Metal Cans	11.2
342	Cutlery, Hand Tools, and General Hardware	2.8
343	Heating Apparatus (Except Electric) and Plumbing Fixtures	7.3
344	Fabricated Structural Metal Products	2.8
345	Screw Machine Products, and Bolts, Nuts, Screws, Rivets and Washers	2.9
346	Metal Stampings	6.2
347	Coating, Engraving and Allied Services	1.5
348	Miscellaneous Fabricated Wire Products	3.1
3491	Metal Shipping Barrels, Drums, Kegs and Nails	13.7
349	Miscellaneous Fabricated Metal Products	1.4
351	Engines and Turbines	1.5
352	Farm Machinery and Equipment	0.9
353	Construction, Mining, and Materials Handling Machinery and Equipment	2.2
354	Metalworking Machinery and Equipment	2.9
355	Special Industry Machinery, Except Metalworking Machinery	0.7
356	General Industrial Machinery and Equipment	1.3
357	Office, Computing, and Accounting Machines	0.8
358	Service Industry Machines	1.5
359	Miscellaneous Machinery, Except Electrical	1.4
361	Electric Transmission and Distribution Equipment	0.8
362	Electrical Industrial Apparatus	0.7
363	Household Appliances	2.4
364	Electric Lighting and Wiring Equipment	2.2
365	Radio and Television Receiving Sets, Except Communication Types	0.8

TABLE B-1

Industrial Waste Generation Factors (Continued)

SIC No.	Name	Generation Factor (tons/employee/year)
366	Communication Equipment	1.9
367	Electronic Components and Accessories	1.0
369	Miscellaneous Electrical Machinery Equipment, and Supplies	2.8
371	Motor Vehicles and Motor Vehicle Equipment	2.4
372	Aircraft and Parts	1.2
3731	Ship Building and Repairing	37.0
3732	Boat Building and Repairing	4.1
374	Railroad Equipment	6.2
375	Motorcycles, Bicycles, and Parts	2.9
379	Miscellaneous Transportation Equipment	1.7
381	Engineering, Laboratory, and Scientific and Research Instruments and Associated Equipment	1.1
382	Instruments for Measuring, Controlling, and Indicating Physical Characteristics	0.4
383	Optical Instruments and Lenses	0.5
384	Surgical, Medical, and Dental Instruments and Supplies	2.3
385	Ophthalmic Goods	2.6
386	Photographic Equipment and Supplies	0.4
387	Watches, Clocks, Clockwork Operated Devices, and Parts	0.6
391	Jewelry, Silverware, and Plated Ware	0.8
393	Musical Instruments	0.6
394	Toys, Amusement, Sporting and Athletic Goods	1.7
395	Pens, Pencils, and Other Office and Artists' Materials	0.5
396	Costume Jewelry, Costume Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal	0.3
399	Miscellaneous Manufacturing Industries	2.0

1) Includes the waste in the remainder of the 4-digit codes under this 3-digit code.

TABLE B-2

HAUL COST FACTORS

Type of Truck	Capacity, yd^3	Compacted Density lbs/yd^3	Cost of Truck($)	Life of Truck(yr)	Daily Operating Cost ($)	No. In Crew		Wages, $/hr. (3)				Work-Day (Hrs.)	Work-Week (Days)	Haul Cost ($/ton-hr.)	
								Chicago		Downstate					
						Driver	Laborer	Driver	Laborer	Driver	Laborer			Chicago	Downstate
Rear Loading Compactor	16	500	17,175	5	40	1	1	7.19	6.56	5.70	5.10	8	5	5.10	4.36
Rear Loading Compactor (Municipal	25	500	20,772	5	35	1	2	7.19	6.56	5.70	5.10	8	5	4.28	3.66
Rear Loading Compactor (Private)	25	800	30,444	5	35	1	2	7.19	6.56	5.70	5.10	8	5	2.76	2.32
Front Loading Compactor	30	800	42,875	5	40	1	0	7.19	-	5.70	-	8	5	1.35	1.23
Tilt Frame & 13 Containers	42	500	42,325(1)	5	35	1	0	7.19	-	5.70	-	8	5	1.98	1.75
Tractor & 2 Transfer Trailers	75	500	75,800(2)	5	52	1	0	7.19	-	5.70	-	8	6	1.10	1.00*

(1) Includes the cost of the 13 containers.
(2) Includes the cost of the 2 transfer trailers.
(3) Includes fringe benefits.
* $1.40/Ton-Hr. For Vehicles operated 6 hours per day

ASSUMPTIONS FOR HAUL COST CALCULATIONS

Chicago Area

Assumptions:

1. 45% residential, 30% industrial, & 25% commercial solid waste.
2. 50% private and 50% public collection in the residential sector.
3. Only private collection in the industrial and commercial sectors.
4. 24 yd^3 compactor trucks used for residential collection.
5. Tilt-frame trucks used for industrial collection.
6. 30 yd^3 front loading compactor trucks used for commercial collection.
7. 5 loads/day by tilt-frame trucks.
8. 3 loads/day by front loading compactor trucks.

Haul Costs:

1. From collection route to intermediate facility or disposal site, collection vehicles operate 8 hours per day.
2. From intermediate facility to disposal site, vehicles operate 8 hours per day - $1.10/ton-hr.

Downstate

Assumptions:

1. 75% residential, 15% industrial, and 10% commercial solid waste.
2. 50% private and 50% public collection in the residential sector.
3. Only private collection in the industrial and commercial sectors.
4. 25 yd^3 compactor trucks used for residential collection.

5. Tilt-frame trucks used for industrial collection.

6. 30 yd^3 front loading compactor trucks used for commercial collection.

7. 5 loads/day by tilt-frame trucks.

8. 3 loads/day by front loading compactor trucks.

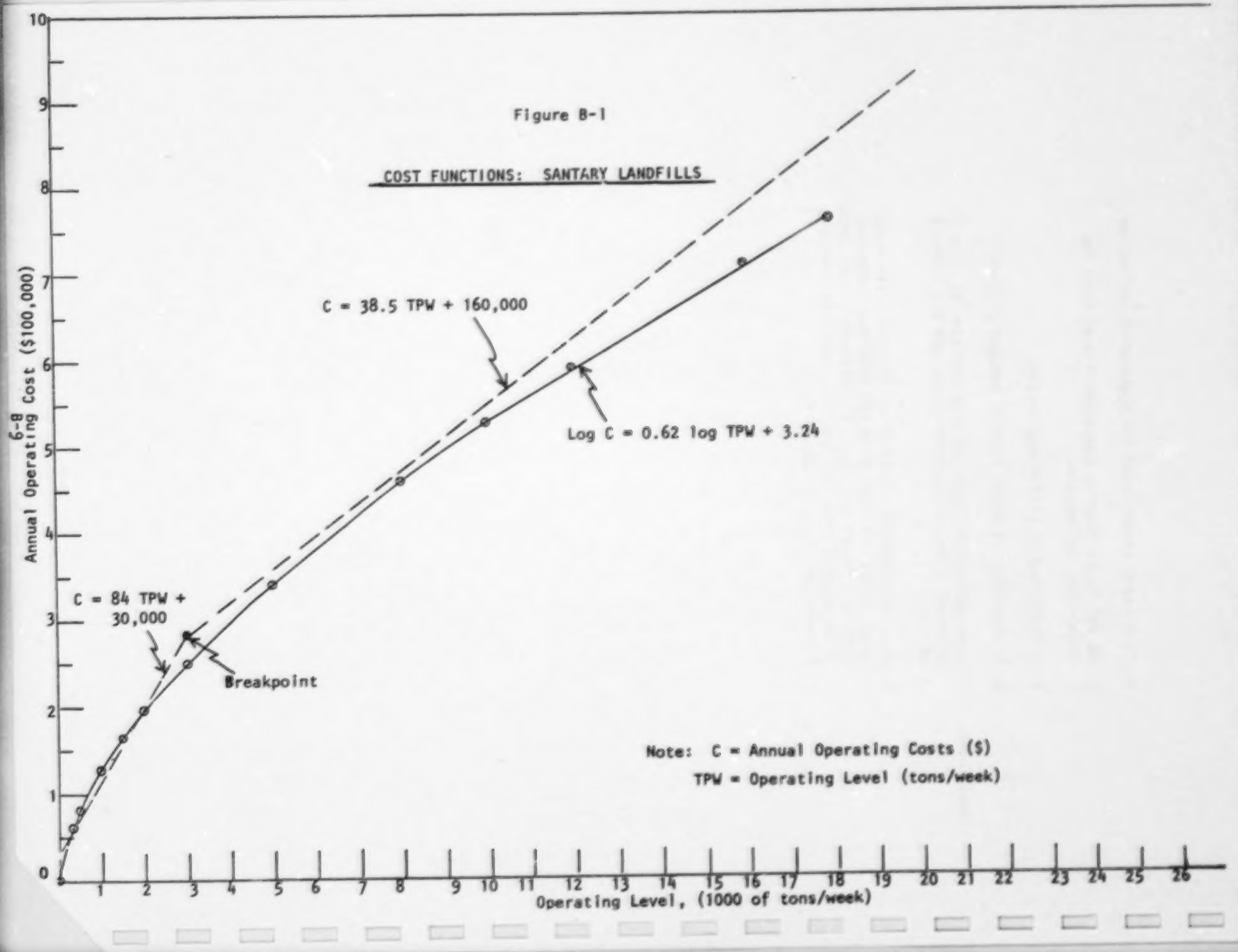
Haul Costs:

1. From collection route to intermediate facility or disposal site, collection trucks operate 8 hours per day.

2. From intermediate facility to disposal site where total loads are less than 150 tons/day, vehicles operate 6 hours per day - $1.40/ton-hr. For total loads greater than 150 ton/day, vehicles operate 8 hours per day - $1.00/ton-hr.

Figure B-1

COST FUNCTIONS: SANTARY LANDFILLS


Annual Operating Cost ($100,000)
Operating Level, (1000 of tons/week)
C = 38.5 TPW + 160,000
Log C = 0.62 log TPW + 3.24
C = 84 TPW + 30,000
Breakpoint
Note: C = Annual Operating Costs ($)
TPW = Operating Level (tons/week)

BASIC LANDFILL COST ASSUMPTIONS

TABLE B-3
ASSUMING EXCAVATION DONE BY RENTED OR LEASED UNIT

50 TPW

EQUIPMENT TABLE A

Farm	CAPITAL COST		OWNING		O&M
Tractor & Loader or Blade	$15,000	@ 22%	$3,600	@24%	$3,300
Fuel	500		119		50
	$15,500		$3,719		$3,350

PERSONNEL COST-TABLE B

Supervisor & Operator @ $11.50/Hr. and fringe for 2 days a week - $184./Wk.
$9568./Per Year

FACILITY COST ESTIMATE- TABLE C

		Yr.	CC	@%	AC
1.	Design	25	$ 9,000	8	720
2.	Preparation	25	12,000	8	840
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	$15,500		3,719
	Sub-Total		$37,500		
5.	Supervision & Inspection	25	2,510	8	201
	Sub-Total		$40,010		
6.	Contingency 10%	25	4,001	8	320
	Sub-Total		$44,011		
7.	Legal 3%	25	1,320		106
	Sub-Total		$45,331		
8.	Bond Discount 3%	25	1,360		109
	TOTAL CAPITAL COST		$46,691		6095.

ANNUAL COST	
A. Sum of 1-8	$6,095
B. Equipment	3,350
Facility CC-3 50% of	500
Miscellaneous 3% of CC-2	360
C. Salaries	9,568
Overhead	
Total Annual Cost	$19,873
Annual Cost/Ton	$ 7.64
@ 52 Weeks	
@ 50 TPW	

O&M- OPERATION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@$ - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-4

BASIC LANDFILL COST FUNCTION ASSUMPTIONS

100 TPW

EQUIPMENT TABLE A

	CAPITAL COST	OWNING		O&M	
Tractor & Loader or Blade	$15,000	24%	$3,600	30%	$4,500
Fuel	500		119		50
	$15,500		$3,719		$4,550

PERSONNEL COST TABLE B

Supervisor and Operator @ $11.50/Hr. include Fringe for 4 days a week - $19,136

FACILITY COST ESTIMATE TABLE C

		YR	CC	@%	AC
1.	Design	25	$10,000	8	$ 800
2.	Preparation	25	13,000	8	1,040
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	15,500		3,719
	Sub-Total		$39,500		
5.	Supervision & Inspection	25	3,020		242
	Sub-Total		$42,520		
6.	Contingency - 10%	25	4,252		340
	Sub-Total		$46,772		
7.	Legal 3%	25	1,403		112
	Sub-Total		$48,175		
8.	Bond Discount 3%	25	1,445		116
	TOTAL CAPITAL COST		$49,620		$6,449

ANNUAL COST	
A. Sum of 1-8	$ 6,449
B. Equipment	$ 4,550
Facility 50% of CC-3	500
Miscellaneous 3% of CC-2	390
C. Salaries	$19,136
Total Annual Cost	$30,975
Annual Cost/Ton @ 52 Weeks @ 100 Tons	$5.96

O&M- OPERTION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-5

BASIC LANDFILL COST ASSUMPTIONS

250 TPW

EQUIPMENT TABLE A

	YEAR	CAPITAL COST	%	OWNING	%	O & M
Crawler	5	$36,000	24	$8,546	22	$8,000
Fuel	5	500	24	119		50
		$36,500		$8,665		$8,050

PERSONNEL COST TABLE B

		ANNUAL
1 Laborer $4/Hr.- 2080	Fringes	$8,320
1 Operator & Supervisor $11.50/Hr - 2080	"	24,000
		$32,320

FACILITY COST ESTIMATE TABLE C

		Yr.	CC	@%	AC
1.	Design	25	$11,000	8	$ 880
2.	Preparation	25	14,000	8	1,120
3.	Building Facilities	25	1,000	8	80
4.	Equipment	varies	36,500		8,665
	Sub-Total		$62,500		
5.	Supervision & Inspection 2% of 4	25	3,330	8	266
	Sub-Total 10% of 1-3		$65,830		
6.	Contingency 10%	25	6,583	8	527
	Sub-Total		$72,413		
7.	Legal 3%	25	2,172	8	174
	Sub-Total		$74,585		
8.	Bond 3%	25	2,238	8	179
	TOTAL CAPITAL COST		$76,823		$11,891

ANNUAL COST	
A. Lines 1-8	$11,891
B. Equipment	8,050
Facility 50% of CC-3	500
Miscellaneous 3% of CC-2	420
C. Salaries	$32,320
Total Annual Cost	$53,181
Annual Cost/Unit	$ 4.13/Ton

O&M- OPERATION AND MANTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-6

BASIC LANDFILL COST ASSUMPTIONS

500 TPW

EQUIPMENT - TABLE A

	YEAR	CAPITAL COST	%	OWNING	%	O&M
Crawler 195Hp	5	$58,000	24	$13,779	24	$13,800
Fuel	5	800		190		100
Scales	10	$ 7,500	14	1,019	8	600
		$66,300		$14,988		$14,500

LABOR TABLE B

Supervisor Scale Man $4/Hr. $5/Hr.	$11,000
Operator @ $11.50 for 2080 Hr.	24,000
Laborer $4.00/Hr. for 2080 Hr.	8,320
	$4 ,320

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	AC
1.	Design	25	$15,000	8	$ 1,173
2.	Preparation	25	20,000	8	1,565
3.	Building Facilities	25	8,000	8	640
4.	Equipment	Varies	66,300		14,988
	Sub-Total		$109,300		
5.	Supervision & Inspection	25	5,626	8	450
	Sub-Total		$114,926		
6.	Contingency 10%	25	11,493	8	919
	Sub-Total		$126,419		
7.	Legal 3%	25	3,793	8	303
	Sub-Total		$130,212		
8.	Bond Discount 3%	25	3,906	8	312
	TOTAL CAPITAL COST		$134,118		$20,350

ANNUAL COST

A.	Line 1-8	$20,350
B.	Equipment	14,500
	Facility ≈50% of CC-3	3,500
	Miscellaneous 3% of CC-2	600
C,	Salaries	43.320
	Total Annual Cost	82,370
	Annual Unit Cost	$3.16/Ton

O&M- OPERTION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-7

BASIC LANDFILL COST ASSUMPTIONS
1000 TPW

EQUIPMENT - TABLE A

	YR.	CC	%	OWNING	%	OPERATION & MAINTENANCE
1 115Hp Crawler	5	$ 36,000	24	$ 8,546	22	$ 8,000
1 170Hp Crawler	5	52,000	24	12,345	22	12,000
1 Fuel Port	5	3,000	24	712	7	200
Scales	10	10,000	14	1,359	10	1,000
		$101,000		$22,962		$21,200

PERSONNEL - TABLE B

Super & Scalemen	1	@ 2080 Hr. @ $8.17/Hr.	$17,000
Equip. Oper. 1.5	1.5	$24,000/Year	36,000
Labor	2		16,640
			$69,640

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	A.C.
1.	Design	25	$ 17,500	8	$1,369
2.	Preparation	25	25,000	8	1,956
3.	Building Facilities	25	8,000	8	640
4.	Equipment	Varies	101,000	-	22,962
	Sub-Total		$151,500		
5.	Supervision & Inspection	25	7,070	8	566
	Sub-Total		$158,570		
6.	Contingency 10%	25	15,857	8	1,269
	Sub-Total		$174,427		
7.	Legal 3%	25	5,233	8	418
	Sub-Total		$179,660		
8.	Bond Discount 3%	25	5,390	8	431
	TOTAL CAPITAL COST		$185,050		$29,611

A.	Line 1-8	$29,611
B.	Equipment	21,200
	Facility 50% of CC-3	4,000
	Miscellaneous 3% of CC-2	750
		$55,561
C.	Salaries	69,640
	Total Annual	$125,201
	Annual Unit Cost at 962 T/W at 52 W/Yr.	$2.50/Ton

O&M- OPERATION AND MAINTENANCE
Yr,- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-8

BASIC LANDFILL COST ASSUMPTIONS

2000 TPW

EQUIPMENT TABLE A

	YR.	CAPITAL COST	%	OWNING	%	O&M
Crawler 195 Hp.	5	$ 58,000	24	$13,770	24	$13,800
Crawler 300 Hp.	5	86,000	24	20,417	22	19,000
Front End Loader 100 Hp.	5	31,000	24	7,360	19	6,000
Fuel Supply	5	5,000	24	1,187	8	400
Scale	10	11,000	14	1,495	14	1,500
		$191,000		$44,229		$40,700

PERSONNEL COSTS TABLE B

Supervisor & Scale	1 @ 2080 @ $8.2/Hr.	$17,056
Laborer	2 @ 2080 @ $4./Hr.	16,640
Equip. Operator	2.5 @ $11.50/Hr and 2080 Hrs.	59,800
		$93,496

FACILITY COST ESTIMATE TABLE C

		YR.	CC	@%	AC
1.	Design	25	$20,000	8	$ 1,565
2.	Site Preparation	25	30,000	8	2,347
3.	Building Facilities	25	21,620	8	1,691
4.	Equipment	Varies	191,000	-	44,229
	Sub-Total		$262,620		
5.	Supervision & Inspection	25	10,982	8	879
	Sub-Total		$273,602		
6.	Contingency - 10%	25	27,360	8	2,189
	Sub-Total		$300,962		
7.	Legal 3%	25	9,029	8	722
	Sub-Total		$309,991		
8.	Bond Discount 3%	25	9,299	8	744
	TOTAL CAPITAL COST		$319,290		$54,366

ANNUAL COST

A. Lines 1-8	$54,366
B. Equipment	40,700
Facility 50% of CC-3	10,810
Miscellaneous 3% of CC-2	900
C. Salaries	93,496
Total Annual Cost	$200,272
Annual Unit Cost	$2.00/Ton

O&M- OPERATION AND MAINTENANCE
Yr.- NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST
@% - % CAPITAL RECOVERY PER YEAR
AC- ANNUAL CAPITAL RECOVERY VALUE

Table B-9

BASIC LANDFILL COST ASSUMPTIONS

5000 TPW

EQUIPMENT TABLE A

NO.	YR.	CAPITAL COST	%	OWNING	%	O&M
1. Crawler 195Hp.	5	$ 58,000		$13,770		$13,800
2. Crawler 300Hp.	5	86,000		20,417		19,000
170Hp.	5	52,000		12,345		12,000
1. Loader 300Hp.	5	31,000		7,360		6,000
1. Scraper 150Hp.	5	49,000		11,633		18,000
1. Truck Pick-Up	4	4,000	29	1,160	46	1,840
1. Fuel Truck	5	13,000	24	3,086	35	4,500
1. Water Tank Truck	5	12,000	24	2,849	35	4,000
Motor Grador	5	31,000	24	7,360	13	4,000
Scale	10	25,000		3,397		3,000
		$361,000		$83,377		$86,140

PERSONNEL COSTS TABLE B

5 Operators @ $11.50/Hr. @2080	$120,000	
4 Laborer $4.00/Hr.	33,280	
2 Scale Operator @ $11066./Year	22,132	Based on Ratio of Lab/Sc.Op.
1 Supervisor @ $17,000 @ $8.2/Hr.	17,000	Based on Ratio of Sc. Op/Sup.

FACILITY COST ESTIMATE TABLE C

	YR.	CC	@%	AC
1. Design	25	$ 25,000	8	$ 1,956
2. Preparation	25	40,000	8	3,129
3. Building Facilities	25	27,244	8	2,131
4. Equipment	Varies	361,000	-	83,377
Sub-Total		$453,244		
5. Supervision & Inspection	25	16,444		1,316
Sub-Total		469,688		
6. Contingency 10%	25	46,969		3,758
Sub-Total		$516,657		
7. Legal 3%	25	15,500		1,240
Sub-Total		$532,157		
8. Bond Discount 3%	25	15,965		1,277
		$548,122		$98,184

O&M - OPERATION AND MAINTENANCE
Yr. - NUMBER OF YEARS AMORTIZED OVER
CC - CAPITAL COST

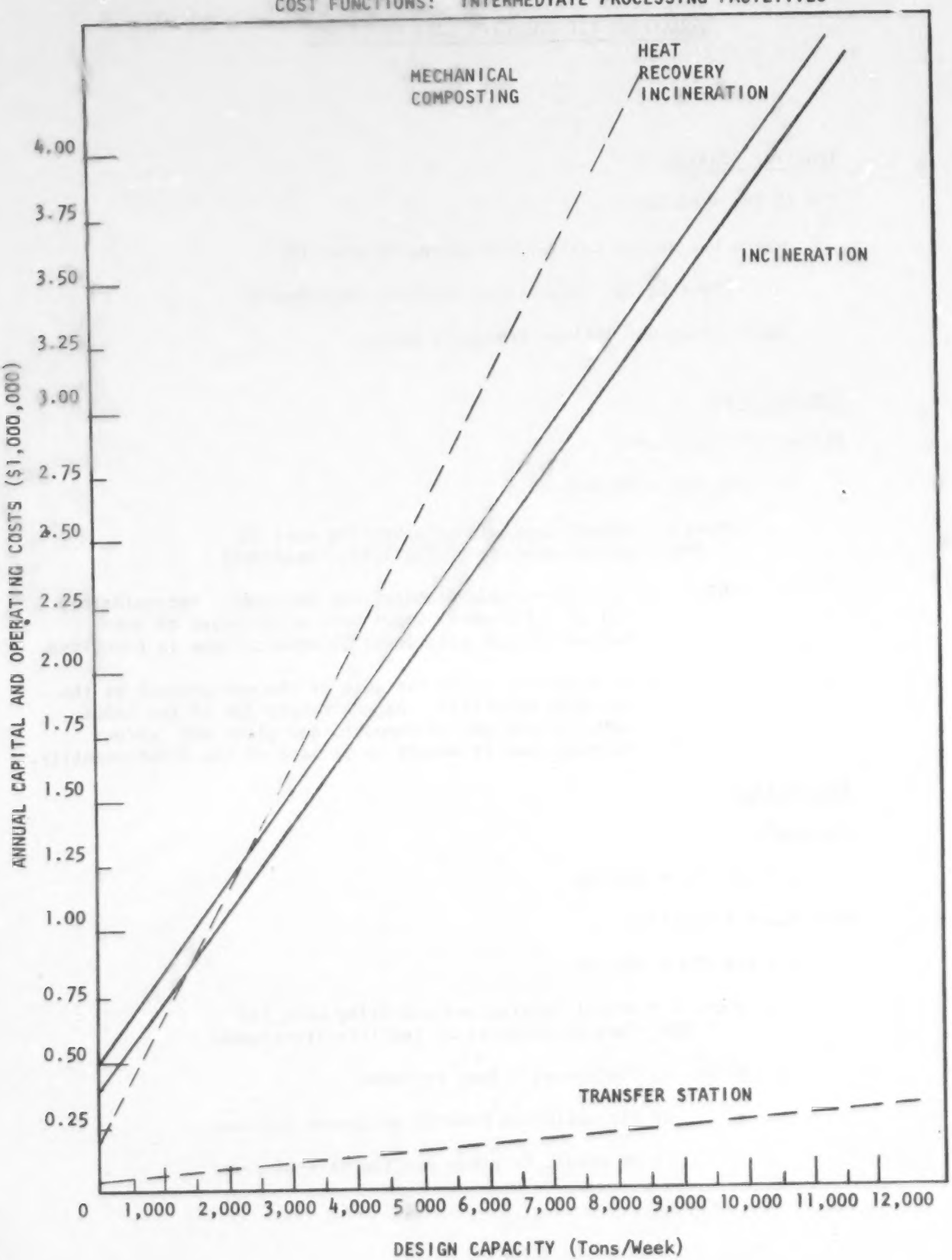
@% - % CAPITAL RECOVERY PER YEAR
AC - ANNUAL CAPITAL RECOVERY VALUE

TABLE B-9 Continued

A.	Sum 1-8	$98,184
B.	Equipment	86,140
	Facility	13,622
	50% of CC - 3 Miscellaneous	1,200
C.	3% of CC - 2 Salaries	$192,412
	Annual Cost	$391,558
	Annual Unit Cost	$1.50/Ton

Figure B-2

COST FUNCTIONS: INTERMEDIATE PROCESSING FACILITIES



EQUATIONS FOR FACILITY COST FUNCTIONS

Transfer Station

$C = 22\ TPW + 40{,}000$

Where C = Annual capital and operating cost ($)

TPW = Design capacity of facility (tons/week)

NOTE: Does not include transport costs.

Compost Plant

Mechanical Digestion:

$C = 500\ TPW + 200{,}000$

Where C = Annual capital and operating cost ($)
TPW = Design capacity of facility (tons/week)

NOTE: 1) Cost of residue disposal not included. Approximately 15% of solid waste input must be disposed of when salvage is not practiced; 5% when salvage is practiced.

2) No credit is given for sale of the end product or the salvaged materials. Approximately 33% of the input quantity emerges as compost, and glass and ferrous salvage usually amount to 5% each of the input quantity.

Incinerator

Standard:

$C = 320\ TPW + 400{,}000$

With Power Production

$C = 340\ TPW + 500{,}000$

Where C = Annual capital and operating cost ($)
TPW = Design capacity of facility (tons/week)

NOTE: 1) Continuous - feed furnaces

2) Air pollution control equipment included

3) No credit is given for the sale of power

Sanitary Landfill

Capital Cost: Consultant's estimate for each individual case.

Operating Cost:

$C = 84\ TPW + 30{,}000$ when $TPW \leq 3{,}000$
$C = 38.5\ TPW + 160{,}000$ when $TPW > 3{,}000$

Where C = Annual operating cost ($)
TPW = Operating level (tons/week)

The curve that best fit the cost data is described by the following equation:

$$C = 0.62 \log TPW + 3.24$$

Since only linear equations are acceptable to the optimization routine, two linear equations were fitted to the curve aroung the specified breakpoint which yielded the two linear equations above.

RESOURCE RECOVERY FACILITY AND COST

The following system was designed to process up to 750 tons per day of municipal solid waste based upon a 2-shift operation. The system will shred all waste, magnetically separate ferrous metals and separate heavy and light fractions. Two shredders are provided to assure continuous service. The system will produce: shredded fuel, ferrous metals, and a mixture of glass and non-ferrous metals.

This estimate does not include the power plant handling and transportation costs. Included in the building cost is a pile foundation.

This system was designed in 1973 for the City of New Orleans by the National Center for Resource Recovery, but has not been constructed. The construction and operating costs included herein are unvarified estimates of cost.

TABLE B-10

FACILITY (750 Tons/Day, 2 Shift)

	MATERIALS	LABOR
Scale	57,375	6,715
Front End Loader	58,300	-
Municipal Solid Waste Conveyor System	201,235	14,740
Reject Bin (large objects)	6,985	-
Trommel Screen	143,185	11,120
Trommel Discharge Conveyor	12,445	19,085
Shredder Feed Conveyor	20,005	19,085
Shredder (2)	569,615	18,790
Shredder Discharge Conveyor	45,545	805
Air Classifier	270,960	42,190
Magnetic Separator	28,000	7,000
By-pass Conveyor	25,380	2,115
Shredder Materials Conveyor System	58,235	2,115
Heavy Materials Conveyor System	25,875	4,935
Electrical System	51,650	10,075
	$1,574,890	$158,770
Building, Receiving (1,000 Ton Storage)	182,880	14,590
Asphalt Apron	14,750	12,010
Shredder Building	113,305	79,500
	$ 310,935	$106,100
Engineering, Contingencies, Profit	510,385	
Total Cost	$2,661,080	

TABLE B-10 (Continued)

OPERATING COST

Amortization (10 Years @ 8%)	
2,661,080 (CRF 10 Years @ 8%) 0.149 ÷ 12 =	45,500
Power, water	14,538
Shredding	23,469
Recovery	28,608
Cost per Month	$112,015
Total Annual Cost	$1,340,000

750 Tons/Day x 6 Day/Week x 52 Weeks/year = 234,000 Tons/Year

Cost per Ton = $5.73

@ 500 Tons/Day x 312 Days/Year = 156,000 Tons

Cost Per Ton = $8.60